Engineering News-Record

A Consolidation of Engineering News and Engineering Record
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Building the Calumet-Sag Channel, Chicago

Electric dinkey hauls concrete for 1400 ft. of retaining wall where two railroad lines cross. By using heavy construction plant contractor cuts down on labor force.

Cover released by courtesy of Concrete Steel Co., New York City

Kreolite Lug Wood Blocks

"The Paving that's Saving"

FOOTHOLD

When the big draft team labors up the steep grade with the heavy load they get a *purchase* on the pavement—if it's of Kreolite Lug Wood Blocks. The lugs on each block hold the blocks apart, providing a small space between. And furthermore, you get a pavement that will not buckle or "bleed," and which is quiet and durable. In short—trouble-proof. In use on grades as high as 6%.

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
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AND CONTRACTING

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"Is This My Boy?"

WE URGED in these columns several weeks ago that it was the duty of everyone to help the country to get on a footing comparable to Germany's. The difficulty in accomplishing this quickly is due to the failure of the individual to make a personal application of the grimness of the war. If we could visualize our own sons standing in a front-line trench at dawn; see them spring to action as the barrage fire ceases, and straighten themselves; follow them over the top, plunging through shell craters, to be stopped by a bullet from a German machine gun; and then be with them through a day of writhing agony, under a parching sun in No Man's Land, or in a jolting ambulance—if we, each of us, could have such a picture with us daily, there would be no profiteering, no strikes, no action that would embarrass those boys at the front, that would leave them without ammunition, or food or warm clothing, that would rob our guns of their shells and explosives, that would curtail shipping and thus keep the needed supplies or reinforcements from France. That our readers may make this personal application, and spread the thought wherever they have influence, we inclose with this issue a picture with the caption, "Is This My Boy?" The picture is an unusual one to go with an engineering journal. But these are unusual times. We are, first of all, American citizens, then engineers and contractors.

Medical Students and Engineering Conscripts

NO ONE who gives more than a passing thought to industrial conditions is willing to minimize the primal need, in our civilization, for the man of engineering training. Yet the war and its operations have so seriously depleted the attendance at technical schools that the next, in fact even this generation, may be seriously crippled in its normal development. How it became possible to take engineering juniors and seniors from schools through the action of the selective draft can be answered satisfactorily only by the assurance that they will be returned—in fact, that they will be refused permission to join any military department until they have received their diplomas or have fully satisfied the authorities that they would have been part of the number normally weeded out at the end of every year through inefficiency or ineptitude. They count no more than one if their course is not completed, and the thousand odd which they number altogether is insignificant in comparison with the future need the country will have for them. No unheard of proposal is this. This journal has urged it repeatedly. Medical students are exempt, and properly so. But who is seriously to affirm that a third or fourth year medical student is of more value, now or in the future, than an engineer with the same amount of training? Questions of this sort need a broader, more intelligent handling, and it is a reflection on the engineering profession that we are so loosely, so ineffectually organized and so weakly led that such a situation can arise and find no agency charged with the care of these things, or strong enough to circumvent its potential destructiveness. The need for action, and now only the national engineering societies can take it, is clearly shown by the data on college enrollment on page 1001 of this issue.

A Quick and Patriotic Move

LAST WEEK for a few days the danger of a railroad strike loomed large. The ghost supposed by a few to have been laid low by the Adamson Law reappeared. Less than a year after that law went into effect the railway brotherhoods, spurred no doubt by the abnormal cost of living and the abnormal wage scale in many industrial lines, forgot their promises not to hamper the Government during the war, and made new demands exceeding those of 1916. Obviously the railroads, hard pressed under present conditions, could not meet the new demands. But the managers, if not the employees, realized as clearly that a strike, or even the threat of one, could not be tolerated in these war times. So they have put their case entirely into the Government's hands, and the brotherhoods, to escape public condemnation, could not do otherwise than follow suit. The outcome may be higher pay and so greater public expense than would result if a fight were made; but the important thing is that there will be no strike.

Engineers Lead in City Manager Profession

THAT the management of cities has become established as a profession, with engineers as its leaders, was shown by the fourth annual convention of the City Managers' Association, held at Detroit last week. As in so many other new fields, engineers have come to the front in this one at a time when no specific or complete training for the work was available. This has been made easier because so large a part of city work is engineering in character, while most of the work of many engineers is administrative. Nearly all the city

managers at the Detroit convention were engineers. If the percentage—80 to 90—does not hold good among executives of enterprises generally, that only goes to emphasize the leadership of the engineers among the city managers. In order that the lead of the engineers may be maintained and, more important still, the success of this new profession be insured, no engineer who aspires to a city managership should fail to recognize that the position requires executive ability, tact, broad vision and deep human sympathy. Without these qualities a candidate will surely fail.

The Work Before the State Highway Departments

WHEN we entered the war there was a tendency on the part of some highway officials to abandon road work—evidently on the theory that it was not a war essential. Unfortunately the issuance of Priority Order 2 which, among other things, prohibited the shipment of road materials in open cars, has seemed to justify this theory. News of the intention to raise the prohibition in the early spring, if possible, and of the appointment of the Highways Transport Committee has not traveled as fast as the priority prohibition.

This is unfortunate. The time demands a hitherto unprecedented activity on the part of the state highway departments. If highways are a war necessity (and this journal, fully supported by the telegrams appearing on page 1032 of this issue, believes that they are) it is vital to secure authoritative data at once and to plan for the improvement and maintenance of congestion-relieving roads.

The first step would seem to be the determination of what highways in a given state can be used as a substitute for twenty- or thirty- or fifty-mile railroad and express routes which may be so badly congested that they are holding up essential industries. Once they are determined, funds can be allocated to them and financial assistance obtained from local communities.

Then the matter of securing contractors will need attention. For two reasons there was relatively little highway work this year:

1. The contractors were unwilling to take the risks due to the uncertain labor and material markets, and the difficulty of securing deliveries, or

2. The contractors, desiring to protect themselves, bid so high that the tenders had to be rejected.

It is necessary that the contractors be relieved of at least some of the risks. The states may assume responsibility for the delivery of materials either by direct purchase or by agreements with the material companies. Contractors, if assured of materials, can well assume responsibility for the labor.

The last step is to determine the railroad cars necessary to transport the materials for these highways and to secure the cars, or authorization for them, from the Priority Board.

Even if cars were now available the preparation of a real war-emergency road program is needed. During the continuance of the war the supply of cars will be uncertain and, even if cars are plentiful, material may be refused in order to force workmen into munitions-making plants. This is what has actually happened in England to every activity which could not prove itself a war service. On the other hand, so keen is the appreciation in England of the value of highway transport as a war measure that the grants for road work by Parliament are greater this year than ever before. The state, therefore, which has not worked out its program on a war-emergency basis is leaving its industrial and business life unprotected by the insurance afforded by highway routes that serve as a substitute for short-haul express and freight service.

It would be well to prepare, in addition to this war-emergency program, a supplementary scheme for the improvement of less important roads that could be proceeded with should it be possible to secure additional labor and materials. Every farm road put in better condition will help to relieve the food tension and decrease by so much the labor involved in starting products on the way to market and to France.

The Highways Transport Committee will naturally take up some or all of the elements of the plan herein suggested and bring its influence to bear for their adoption. Now, however, is the time for action. Many roads need attention at once. The committee cannot possibly cover the country quickly with its own resources. It must get the help of the state highway departments. If they are forehanded, appreciate the need and start their planning, the country will so much the sooner meet and solve its highway-war problem.

Structural Progress Through Dead-Load Stress Measurements

THE fact that elaborate measurements of dead-load stress were made on the Hell Gate arch during its erection, as reported in a paper read last week before the American Society of Civil Engineers, marks a new page in the records of structural engineering. The measurements will take rank among the classics of the science. They would merit high regard if they were nothing more than a model of experimental verification of complex design assumptions. But their real importance lies in the increased knowledge they give us concerning stresses. They are the first recorded determinations of dead-load stresses throughout a large structure.

The Hell Gate results should give an impulse toward adopting dead-load stress measurement as a general practice in structural work. It is surprising but true that many structures offer less uncertainty with respect to live-load effects than with respect to the effects due to fixed load and to construction conditions. These latter effects can be measured by the strain gage; the value of the resulting knowledge is clearly illustrated in the Hell Gate case. Consider what is now known of the load-carrying action of the arch, and compare it with what would be known—and what would not be known—if the measurements had not been made.

Live-load stresses have been measured in not a few structures—enough to outline roughly the possibilities of such work, and some of the detail facts as to the stresses. But dead-load stresses have never been measured, or the results have not been published. J. E. Howard some years ago conceived the idea of making such measurements, and started on the work. But he

failed to publish his observations and the measurements were far less extensive than those at Hell Gate.

What stands out prominently from this new work is the clear-cut information it gives as to secondary stresses. That the measured stresses were generally lower than the calculated secondaries is a most useful and encouraging thing to learn, although some bridge engineers had suspected the fact. But it would be dangerous to generalize from the comparison in this one case, for the overshadowing influence of erection methods makes broad rules inapplicable to the question of dead-load secondaries. As likely as not, in another structure of different type the erection methods may produce remanent secondary stresses much greater than the calculated ones. Members are often placed and connected in a shape and angular relation that represents neither the unstressed nor the full-load condition, nor of necessity an intermediate condition; progressive distortion during erection has equally profound influence, and in consequence it is impossible to dogmatize. Dead-load secondaries can be studied in no other way than through strain-gage measurement. D. B. Steinman's analysis of the Hell Gate figures shows that such work gives closely reliable results.

But there is another important object of strain-gage measurement, namely, determination of dead-load direct stresses. As to this phase of the matter, there is chance for much misconception. It is easy to think that direct stresses are mathematically certain, free from all doubt, since the rules of statics are bound to apply. Let it be conceded that this is so in the simplest structures, that their stresses are as definite as the load distribution in a weighing scale; even so, when dealing with large masses of metal it is satisfying to know that the real stresses match the calculated ones. Further, the feeling of absolute certainty concerning stresses may be carried over unnoticed from ideally simple beam-and-column or truss assemblages to complex cases which afford room for serious doubts. For example, the same rules that are used for simple girders are applied to such highly-organized structures as the columns supporting the Manhattan Bridge, immense cellular plate structures subjected to combined compression and bending. These, however, are very far removed from any type of structure in which stress distribution has been explored by test, and our knowledge of the real tax on those great columns would be markedly advanced had the dead-load stresses in them been measured during erection.

Results of three kinds may be obtained through strain-gage measurements under dead-load, results bearing respectively on (1) local stresses at splices, pin plates and similar special details, (2) the uniformity of stress distribution over a large member, or in other words, the unity of action of the member, and (3) dead-load distortion stresses, or secondaries. For every large structure all three subjects are sufficiently involved in uncertainty to make strain-gage measurements an urgently desirable addition to the regular construction routine. Finally, in many types of structure the strain gage can give necessary information as to type. If in the arch it can discriminate between the three-hinged and the two-hinged condition, it can in a building frame determine the degrees of constraint and tell how many members coöperate in resisting certain loads. Without such information we cannot hope to attain safety, efficiency and economy in right conjunction.

Thus the Hell Gate measurements in more than one way furnish a starting point for new progress. The record of the work inspires the conviction that, when once the practice of measuring dead-load stresses becomes common, both the science and the art of structures will see a great advance.

Whither Are We Going?

UNLESS we take time occasionally to detach ourselves from the details of our war preparations and view events as political phenomena, we lose sight of the tremendous changes which have occurred since April in our economic and political structure. We are in a new era. Economically considered, last March is of a different age. The war has brought changes that generations of peace would not have witnessed. A Washington item of last week, that made hardly a ripple, will serve to show how accustomed we have become to radical proposals and how readily we accept doctrines, extreme as measured by the standards of last year, so long as they are "necessary for the war." Washington dispatches had it that plans were being formulated for the establishment of a credit board for the purpose of attending "to the credit needs of manufacturers and contractors who are filling war orders for the United States Government." The report went on to say that among other things the board "will arrange for the financing either by having the Government make them (the manufacturers and contractors) cash advances or by other means."

While we readily assent to the proposal of Government financing, under present conditions we should not blind ourselves to the magnitude of the step. We are extending public credit to private enterprises. That the products are for the Government does not change the fact. The significance of this course appears when we recall that through practically all time the credit power has been in private hands, not in the Government. It has been the bulwark of privilege and the undoing of those who had the vision, the organizing ability, the inventive genius, but were unable to tap credit sources.

But another thought suggests itself in this connection, how much of this war-time coöperation will be allowed to remain after the war? Will the railroads be allowed to continue their coöperative operation, involving pooling and all manner of practices formerly interdicted? (Some will answer by saying that these are steps toward Government ownership.) Will the advisory committees in the various industries be permitted to exist? Will the nation, heretofore against ship subsidies, continue to be an owner, or at least a lessor, of shipping? Will the Government continue to exercise control over essentials, such as iron and fuel and food? In fine, are the national industrial economies which the war has occasioned a permanent acquisition, or will the new structure be swept away when peace comes?

These are not only interesting, but extremely important questions. We do not presume to answer them. We doubt whether they can be answered now. We raise them because they must be answered before long and because engineers should have a part in the answering.

French Engineers Span Aisne River Under Shell Fire

Small Steel Pontons Support First Foot-Bridge—Scows Later Moored To Carry Roadway for Heavy Traffic—Permanent Steel Structure Completed

By Robert A. Drake
Formerly Ambulance Driver, Section 5, American Red Cross, France

BRIDGE construction in war time tests to the utmost the enginer's powers of adaptation and resourcefulness. Quick action and results are necessary, both for saving the lives of the workmen and for preventing the needless destruction of expensive machinery.

French engineers accomplished a notable feat in spanning the Aisne River at ———— during the latter part of April and the first two weeks in June, 1917. On April 15 a terrific curtain fire from the French artillery forced the enemy to bury themselves in their dugouts 1000 yd. from the north bank of the river. The French engineers then faced their first problem in bridging the stream; to make it possible for the French troops to cross the river and establish their lines on the other side. On the south bank, at right angles with the line of flow of the Aisne, 14 steel pontons, each 8 ft. long and 3 ft. in diameter, were laid parallel with one another at intervals of 10 ft. On top of these boats, 10-ft. sections of board walk, made of 3 x 4-in. beams with boards 2½ ft. long nailed across them, were placed so that the joints between the sections were directly over the center of the boats. Large iron hooks fastened the timbers together in order to give flexibility to the floating bridge when the pontons rose or fell as the load on any particular section decreased or increased.

All this work of assembling had to be done under heavy shell fire from the German batteries. At a given signal the engineers pushed the end of the foot-bridge out into the river. Then a new difficulty arose; the current of the stream had such a tendency to carry the floating end of the bridge downstream that the first ponton failed to reach the other bank by 30 ft. The bridge was finally shoved across by letting the whole structure float down the current until its center struck the abutment of the old bridge. Then two men pushed against the masonry until the whole bridge swung up to make a 90-deg. angle with the blank. As soon as the end touched the farther bank, four men made the bridge fast by driving stakes in the earth and fastening steel cables from them to cleats on the first ponton.

Over bridges like these the first French troops charged in numbers that finally forced the Germans to retire to a line of hills ¾ mile from the river. These original foot-bridges were retained even after permanent structures were built, in order to relieve the congestion on the other bridges and also prevent the German balloon observers from estimating the number of troops coming up. The foot-bridges were close to the water and hence better concealed by the banks than the higher wooden or steel spans.

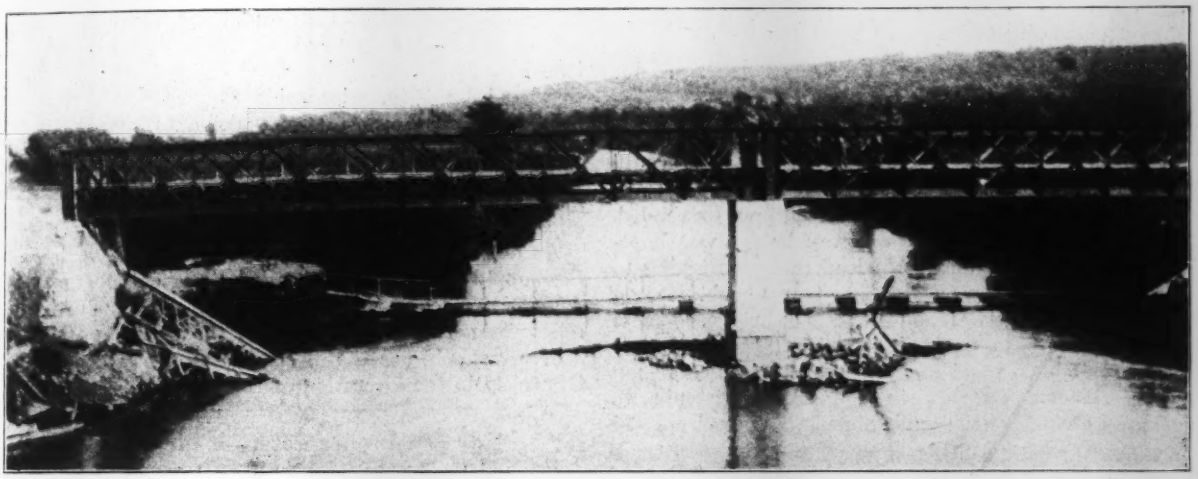
The second problem of the engineers was to provide means for getting trench supplies across the river to the Frenchmen on the north bank. The bombardment was still too heavy to permit an attempt to erect a steel structure, but the small foot-bridges were inadequate in size and strength for supporting the ever-increasing loads of food and trench munitions needed. A bridge large enough for pack mules and small horse-drawn carts was necessary.

The large ponton bridge solved the problem. Seven steel scows, each 35 ft. long, 4½ ft. wide and 3½ ft. deep, were brought up on large six-horse trucks. Each boat was turned bottom up on the flat timber bodies of the trucks, and kept from sliding sideways by a wooden support shaped like a broad U, under each end of the boat, and by ropes fastened from these Us to cleats inside the pontons.

BRIDGE OVER AISNE CANAL—BELOW, RUINS OF BRIDGE DESTROYED BY GERMANS
Note the gasoline tractor and train crossing structure and the section of narrow gage track leaning against the abutment at the right

On the banks of the stream a nawser from one end of each boat was first fastened to a stake driven into the earth. Then the horses pulled the wagon from beneath the boat, and soon after the pontons were launched one after the other with the bows pointing upstream. The planks of the runway on top of the boats were laid diagonally, and fastened at the edges by 8-in. beams that also kept wheels of carts from running overboard. As the floor of this bridge was 15 ft. below the top of the bank, a wooden runway similar to that on the bridge led over the soft, shell-pitted earth from the end of the bridge to the macadam road above. But this large ponton bridge was used only temporarily.

As the Germans were driven back to a point 2½ miles from the river, the third and final problem presented itself to the engineers; to span the river with permanent bridges strong enough to support the weight of the advancing artillery, heavier munition wagons, auto trucks and narrow-gage railroad trains.



FOOT BRIDGE ON PONTONS WAS RETAINED AFTER STEEL STRUCTURE SPANNING MAIN RIVER WAS COMPLETED

All this construction had to be done within full sight of the German observation balloons that signalled their batteries to hinder and, if possible, prevent the work entirely. At another point farther down the river, higher hills on the northern side of the valley cut off the visibility from the enemy balloons to a greater extent, but this factor of safety was sacrificed somewhat in order to utilize the abutments of the old bridge. The Boches had placed heavy charges of nitro-glycerine on the centers of the trusses, and as a result of the explosions the twisted steel, fallen away from the abutments, was lying in the river below. In their haste the Germans had been forced to leave the masonry intact, but the solidity of the stonework was carefully tested by the Frenchmen before they utilized the piers. There was more than a chance that the wily Boches had secretely undermined the stonework.

Before the war, part of the Aisne at this point had been diverted so that two bridges had to be constructed, one a single span 100 ft. long over the canal, and the other a double span, 220 ft. over-all, over the main body of the river.

A narrow-gage railroad was constructed from the engineers' park (supply station), 3 miles farther in the rear, to the river, in order to bring up the steel and other heavy supplies. The hauls were made by a four-cylinder gasoline locomotive that could draw three loaded trucks at a maximum speed of 8 miles per hour.

The motto of the French engineers was: Use expensive machinery under shell fire for as short a time as possible. So the derricks, piledrivers, trusses and other supplies were not brought up until every possible preparation had been made. There was plenty of labor at the front; the conservation of material was the real problem.

Just as the work was well under way, the German aëroplanes "spotted" the increased activity of the engineers and directed the artillery to increase its firing. The hostile aëroplanes also dropped bombs on the works, so the natural difficulties of the engineers' task were considerably augmented by these human hindrances.

I was driving an ambulance in an American Sanitary Section (Section 5, American Red Cross) at the time and our cars carried an average of 7 wounded engineers a day—all hit either on or near the bridge. Although dugouts were provided for the men in case the bombardment became too heavy, the workmen preferred to stay at work in order to finish the construction as soon as possible.

The principle of bridge-separation guided the work of the engineers throughout. Rather than build a single bridge broad enough for traffic going in two directions simultaneously, the Frenchmen erected two narrower bridges separated by at least 150 ft. although the work involved much more time and labor. The purpose of this separation was obvious; during a bombardment the chances of the shells cutting the lines of communication were lessened considerably by decreasing the width of the bridges, and placing the spans at a considerable distance from each other.

I had a good opportunity to observe the practical value of this method of construction one night when the artillery fire was unusually heavy, for the Boches were trying to keep the supply teams from coming up. On the trip down I crossed the bridges safely with my load of wounded, but on the trip back, shells hit both bridges. The wooden bridge I had passed over on my

HOW THE PONTONS ARE LOADED FOR QUICK TRANSPORT FROM REAR TO POINT OF USE

way down was so badly damaged that traffic could not pass over it at all, but—here the advantage of steel over wood construction was clearly evident—although a shell had hit the steel structure, teams and autos could still drive over the river. I crossed the span over the canal without mishap, but once on the island I was stranded. The traffic over the narrow one-way bridge was hopelessly congested by the double load of teams trying to come down as well as go up. Two teams could pass on the island where we were, but not on the bridge, so there was nothing for us to do but to "sit tight" and wait our turn. I have spent many pleasanter moments than that quarter-hour out there in the blackness, listening to the shrieks of enormous shells aimed at a target only 10 ft. away! When it finally came our turn to move, a French teamster behind us galloped ahead and blocked the way. I know enough French to express myself on ordinary occasions, but I knew nothing but vivid English at that moment.

"You blankety blank blank toasted-in-Purgatory Frenchman, you," I yelled, completely forgetting that the poilu couldn't understand a word I was saying, "get out of my way!"

The very evident emphasis of my remarks made some impression on the teamster's mind, if the words didn't. He pulled out to one side of the road and a few seconds later I was safely out of the danger zone.

The workmen could not make any repairs on the bridge that night because "no lights" was the rule so near the trenches, but at daybreak the next morning the reserve staff of engineers, who lived near the bridge to take care of just such emergencies, were at work repairing the shattered railing. The narrow-gage railroad that passed over the steel bridge also needed rebuilding, so the reserve section of combined steel ties and rails was picked up from beside the road and substituted for the broken section.

The *gendarmes*, who lived in dugouts at either end of the bridges, strictly enforced the one-way traffic rule when both roads were open. As these officers had orders to shoot down any driver that disobeyed orders we were careful to drive over the steel bridge when we went toward the lines, and over the wooden bridge when we were going in the other direction. As the munition teams had their heavy loads of shells going up the steel structure was used for all the up-bound traffic.

When the teams or autos approached the bridge the policemen made every vehicle keep at least 50 yd. behind the one ahead. This was done for two reasons—first, to make a more scattered target for the German artillery, and, second, to eliminate a possible overload on the bridges. The macadam road near the approaches was always well sprinkled to keep passing wheels from starring conspicuous clouds of dust that could be seen by hostile observers, and the maximum speed was reduced to 8 miles per hour.

After the bridges were completed camouflage played an important part in protecting the structures from shell fire. All the steel trusses and woodwork were painted a moss green color, the shade of the water below, for the secret of camouflage is to imitate the background as closely as possible. This green paint concealed the bridges from view of German aëroplanes. On either side of the road, at the ends of the bridges nearest the trenches, two 35-ft. poles were erected, and between these poles a ½-in. wire cable supported a screen of heavy chicken wire that hung down to within 10 ft. of the roadbed. Bushes and bits of painted cloth were interwoven in this wire until the whole camouflage made the poles appear exactly like one of the dead trees all along the bank.

As a final precaution against a possible severing of the supply lines, the engineers built a detour that led down the side of the valley across another bridge 2 miles farther downstream. But the question whether a driver should use the direct route or the detour was left solely to the discretion of the individual.

New Los Angeles Reservoir Under Way

Construction has recently been commenced on the Chatsworth reservoir in the upper end of San Fernando Valley, a few miles northwest of Los Angeles, Calif. About 27,000 acre-feet of storage will be thus provided by the nineteenth and last of the reservoirs planned for the Los Angeles aqueduct system. This reservoir calls for the construction of two large earth-fill dams and four smaller dams or dikes spanning gaps between hills.

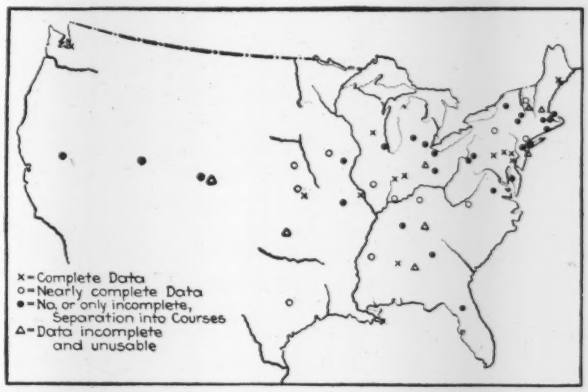
The construction period is expected to extend over more than a year. At the outset there were employed on the work about 250 men, 150 horses and mules, three steam shovels, and three locomotives, with the necessary equipment of small cars. The construction method is similar to that used on other hydraulic dams of the aqueduct; dump cars convey the material from the steam shovels to a conveniently placed sump, whence it is pumped to the dam. The total yardage to be moved on this work is about 1,040,000 cu.yd., of which 740,000 and 190,000 cu.yd. go into the first and second dams respectively.

The main portion of the Chatsworth high line conduit has been finished for several months and serves the adjoining tracts under irrigation. This line will now be extended three miles to bring the aqueduct water to the new reservoir. The conduit is to be completed in time to deliver water next spring and thus take advantage of such storage as the progress of the work on the dam affords by that time.

How the Draft Has Affected Enrollment In Engineering Schools

Seniors and Juniors, Generally Above the Minimum Age Limit, Fail in Large Numbers To Return to School This Fall—Freshmen and Sophomores Affected, Though Not to Same Extent—Chemical Engineering Courses Suffer Less Than the Other Branches—Effect of Depression of 1914 Shown

ATTEMPTING to gage the effect on engineering schools of the entrance of this country into the war, the *Engineering News-Record* sent a letter to 92 institutions requesting information as to the number of students enrolled at the beginning of the scholastic years for the years from 1912 to 1917, inclusive. The request was extended to cover a division of enrollments into civil, mechanical, electrical, and chemical engineering courses. About 60% of those addressed replied to the letter, and of those replying not all submitted data which could be used in the summary of totals which accompany this article. This was to have been expected, but it is believed that a good indication can be obtained from the twenty schools which reported full data on the civil engineering enrollment, the sixteen which reported on mechanical and electrical to the same extent, and the thirteen which gave full figures on their chemical engineering courses.



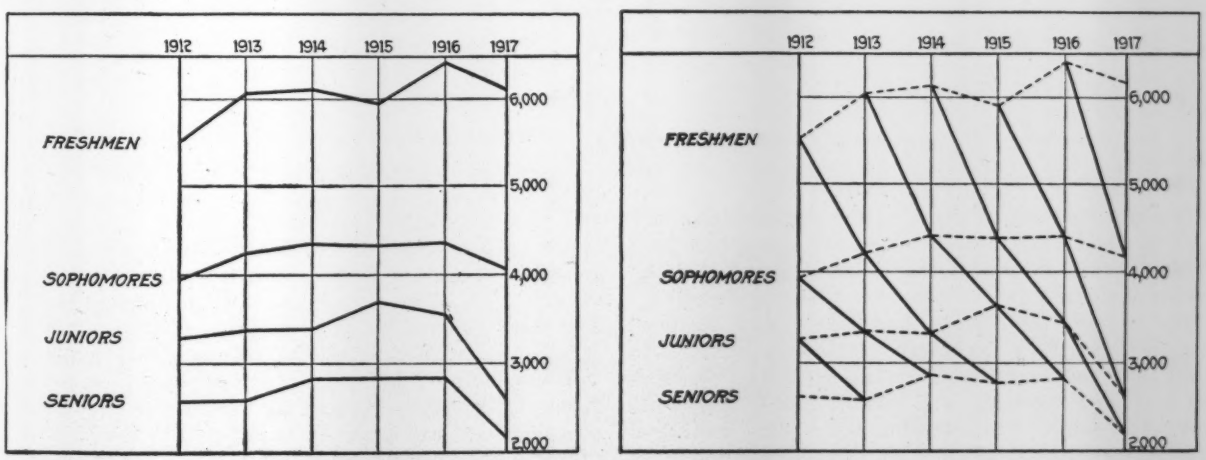
REPLIES SHOW FAIR GEOGRAPHIC DISTRIBUTION

Several rather startling facts stand out besides that sought for. Among these is the effect of the depression of 1914 upon enrollment and the remarkable increase in the number of students taking the chemical engineering course. When considered in conjunction with those taking civil, mechanical, or electrical engineering courses, this is particularly striking, and although it has been noticed before, it is not thought that the extent of this change-over has been fully appreciated. Unfortunately, no request was made which would have brought replies showing the number enrolled for agricultural engineering, but a paper by Prof. Calvin H. Grouch in the October "Bulletin" of the Society for the Promotion of Engineering Education, shows that this course has enjoyed a remarkable popularity, particularly during the last ten years.

But the main interest derivative from the data is the fact that the senior and junior classes were cut as much as 60% in some schools by the operation of the "selective draft" and through voluntary enlistment.

It is not possible to give exact figures in any case, nor would it be justifiable to draw a too definite inference from the partial tabulation appended. It is, however, interesting to point out that while the civil engineering classes of 1916 lost an average of 22% between the enrollment for junior and senior classes, the class of 1917 lost 41%. This is the figure for twenty schools from which sufficiently complete data was obtained, and is even more significant when it is realized that the average loss for the classes of 1913, 1914 and 1915 was only 13% between the senior and junior years.

In the mechanical engineering course the corresponding average loss for the classes of 1913, 1914 and 1915 also was 13%. In this branch the loss for 1916 was 20%, but this fall the enrollment dropped 51%, 10 points more than in the civil engineering course. It is probable that this greater loss may be traced to a drain to the industries.



THE DROOP OF 1914 WAS FULLY MADE UP, BUT THE DRAFT AND ENLISTMENTS HAVE SERIOUSLY DRAINED THE SENIOR AND JUNIOR CLASSES

ENROLLMENT IN VARIOUS COURSES FOR YEARS 1912 TO 1917, INCLUSIVE

No. of Schools Represented At Beginning of Class Year		20 Civil	16 Mechanical	16 Electrical	13 Chemical
1912	Freshman	895	639	784	279
	Sophomore	679	428	533	178
	Junior	557	341	459	116
	Senior	468	220	310	110
1913	Freshman	850	696	864	296
	Sophomore	684	454	518	204
	Junior	543	358	454	148
	Senior	465	289	335	112
1914	Freshman	811	634	863	326
	Sophomore	662	457	550	226
	Junior	520	373	407	190
	Senior	470	307	361	141
1915	Freshman	810	552	768	450
	Sophomore	560	446	574	282
	Junior	526	369	446	202
	Senior	468	335	365	155
1916	Freshman	745	664	752	455
	Sophomore	512	491	521	283
	Junior	443	390	438	195
	Senior	408	294	357	137
1917	Freshman	738	563	711	490
	Sophomore	450	390	405	341
	Junior	283	272	266	172
	Senior	259	191	222	125

The electrical engineering courses for sixteen schools shows several rather individual features when contrasted with the mechanical and civil enrollments. The figures for the years 1913, 1914 and 1915 show a decrease between senior and junior years of 19%; for 1916, 20%; and for 1917, 49%.

In the last classification, that of chemical engineers, the data on thirteen schools shows losses as follows: 1913-14-15, 8%; 1916, 32%; 1917, 40%. This is a mortality appreciably lower than in either the mechanical or electrical courses and very similar in many ways to the characteristic behavior of civil engineering students as shown above. The comparatively greater loss in 1916 may reflect the sudden and extraordinary growth of American chemical industries during that period.

The above analysis is based on only a few schools from which full data was obtained, but it clearly points out many of the effects that recent developments have had on the attendance at technical schools. Other schools to the number of thirty-one forwarded figures covering the same years, but showing no clear separation into courses. In general the conclusions that may be deduced from this incomplete data completely bear out the statements made above though it is impossible to estimate the influence of such courses as architecture and agricultural engineering. The same characteristic droop in 1914 can be detected as well as the greatly diminished senior and junior enrollments of this year. The accompanying curves and diagrams include these figures wherever it was possible so to do and still maintain proportion and proper reverence for accuracy. Partial replies from eleven more schools are confirmatory but not thought worthy of inclusion in either the diagrams, curves or tabulations. Not a few institutions replied that they were so busy and in some cases so "plagued with questionnaires of one sort or another" that they asked our indulgence in their not replying to our request.

Defective Concrete Bridge Floor Surfaced with Brick

BRICK pavement has just been laid on a concrete bridge floor that developed serious wear because of defective concrete. The bridge crosses the Iowa River at Tama, Iowa, and consists of three 95-ft. riveted steel pony-truss spans with reinforced-concrete floor slabs. The steel was erected last fall, and the slab was poured in early winter. Before cold weather the concrete acquired enough strength to allow of stripping the forms, but when traffic was turned on, early in April, the surface soon showed wear, and by midsummer it became evident that some kind of resurfacing was needed. It is believed that delayed set due to cold weather, in combination perhaps with inferior aggregate, was responsible for the lack of hardness.

The concrete slab was considered satisfactory in respect to load-carrying strength, but lacking in resistance to surface abrasion. When requested to put the floor in good shape, the contractor proposed to apply a thin surface coat of rich mixture, but the state highway authorities declined to approve this method of repair. Finally the parties agreed on surfacing with a 3-in. grouted brick pavement, the county to pay half the cost of the brick.

The paving was done in two longitudinal sections, keeping 9 ft., half the width of the bridge, open to traffic. The surface of the concrete was cleaned by scraping and hand brooming, and was then kept thoroughly wet for 24 hours. The following day a ¾-in. coat of 1:2 dry mortar was spread over the surface, and the brick dropped and grouted.

A 3-in. layer of earth over the concrete was allowed for in the original design of the bridge, and the weight of the brick therefore does not reduce the live-load capacity of the structure. Such allowance is regularly made, in the practice of the Iowa State Highway Commission, in the case of concrete floors of pony-truss bridges located on earth roads. On such bridges earth is inevitably dragged on from the road, but often an earth covering is applied intentionally as a means of preventing wear. A bridge not far from the one above mentioned is said to show a maximum wear of 2½ in. in five years since construction; so far as known the concrete of this floor is of average quality for the region.

Thomas H. MacDonald is chief engineer of the Iowa State Highway Commission, which designed the bridge and directed the repairs. John H. Ames is bridge engineer.

Wisconsin Road Board Makes Experiments

Three lines of experiments in road construction are being followed by the Wisconsin Highway Commission. The first deals with the relative values of tars and asphalts as surface treatments for bituminous roads. The second is an attempt to determine the relative values of various types of steel reinforcement in concrete roads. The third subject is the possibility of constructing a serviceable but cheap road by means of hay and tar. The spreading of hay and straw on the roads in sandy parts of the state makes a fair surface for travel, but this does not last long. It is hoped that the tar will preserve and strengthen the layer of hay. The experimental road is giving very promising results.

Illinois Central Raises Line Above Flood Level

Steam Shovels and Dump Cars Handle 5-Foot Lift—Company Work on Old Alignment—Contract Work on Relocations

ELEVATION of its line above flood level for about 50 miles near Vicksburg, Miss., has been undertaken by the Yazoo & Mississippi Valley R.R. (Illinois Central system) in order to avoid interruptions to traffic by overflows which result from the increasing height of flood level in the lower Mississippi valley. This action was decided upon after the severe flood during the winter of 1915-1916, which reached a stage 1.4 ft. higher than any previous record, covered the tracks with 4 ft. of water in places, and stopped traffic for three weeks. The cost of this improvement will be about $1,250,000.

The work consists of raising the grade from 1 to 5 ft. above the present elevation, and includes trestles as well as fill. It extends 21 miles south of Vicksburg and 27 miles north of that city. For most of the distance the change is made on the existing location, and has had to provide for maintaining traffic. At some points, however, improvement is effected by a relocation, throwing the line back along the foothills instead of across the low lands of the overflow district. The work will be completed early in 1918, except through Vicksburg, and plans for the improvement and protection of the line at that point are under consideration.

All the work north of Vicksburg is on the original alignment, and the raising of roadbed and structures had to be done under traffic. For the first 10 miles, to the Yazoo River, the new grade of top of rail is placed at an elevation of 3 ft. above the 1915-16 flood level.

From this point to Smedes, 17 miles, the grade is raised only to the water level of that flood. The reason for this is the probable construction by the U. S. Government of a levee along the Mississippi River, the effect of which will be to reduce the future flood level in the area north of the Yazoo. This levee is proposed by the U. S. Government and will extend from the Terrapin Neck cutoff to the mouth of the Yazoo canal.

Change of grade on the 10-mile section to the Yazoo River was authorized early in 1916 and completed in December, at a cost of $150,000. Changing the 17-mile section north of the Yazoo was authorized in October, 1916. It was begun last March and is to be completed in February, 1918, at a cost of about $375,000.

Both sections include new trestles and the raising of old trestles. The new and the old trestles are mainly ballasted-deck structures, built of creosoted timbers and having 6-pile bents. Where the lift of track on the old trestles was 2 ft. or less, it was made by placing additional caps, well secured by drift bolts. Where the lift was more than 2 ft. the same method was used, but an additional pile was driven at each end of the bent, and the new caps were of such length as to extend over the 8-pile bents.

All the work on this 27-mile stretch is done by the railway. The borrow-pit and work trains are operated by the construction department, and the raising and ballasting of track is done by the division forces. In raising the fills, a top width of 18 ft. is given, with side slopes of 1½:1. The material is clay and rock. An allowance of 10% for shrinkage after the track has been raised to full grade has proved satisfactory. Side borrowing was not permissible on account of drainage conditions. A borrow pit was obtained near Kings, making the average haul 13 miles, and excavation was begun on Aug. 1, 1916. Two steam shovels with 2½-yd. dippers are used. The force at the pit averages 40 men.

Excavated material is handled by 70 steel side-dump cars, of 20-yd. and 30-yd. capacity. These are hauled in trains of 20 cars, four 60-ton locomotives being employed for hauling the trains and spotting them at the shovels. The 20-yd. steel cars have been found very satisfactory for this class of work, especially where the height of fill does not exceed 8 ft. The 30-yd. cars are found to be too large for low fills, but suitable where the fills are of greater height.

The dump cars are operated by air, under control from the engine. Each locomotive is fitted with a three-way valve connected with the pipe-line of the dumping apparatus, so that the engineman can dump all the cars in either direction, according to signal from the foreman at the dump. The maintenance of the steel cars is very light, one car repairer being sufficient to handle the running repairs on 70 cars.

The dumped material is moved clear of the track by a steel spreader-car. This is operated by a 90-ton locomotive, which also helps push the empty train clear of the

EXCAVATING IN A SLIDING CUT ON RELOCATION SOUTH OF VICKSBURG

dumped material. The spreader moves the material far enough to be clear of trains, but not so far as to cause unnecessary expense in throwing it back under the track.

Raising of the track is done in lengths of 1000 ft., with a lift of 1 ft. each, and with a gang of about 40 men to each length. Thus for a raise of 4 ft. there will be four consecutive 1000-ft. lengths, the first one being at the old grade and each of the others 1 ft. above the preceding length. On this stretch of 4000 ft. the track is on a fill with a narrow crown. Beyond it is the final dumping and filling for permanent grade and width of roadbed, with a gang of about 40 men making a light running surface between this work and the adjacent 1000-ft. length, which is still 1 ft. below final grade.

Track jacks are used to make the raise, and earth is then shoveled under the ties. The general plan is to raise the track as high as possible with the material at hand, and then run the dump-car trains on the track thus raised, to deposit material for the next lift. In this way the raising is kept in advance of dumping, giving the track good drainage, which is of great benefit during wet weather.

Cementing-gravel ballast 12 in. thick is laid on the new subgrade. This is obtained from a pit at Whitaker, 106 miles south of Vicksburg. It is hauled in 30-yd. convertible hopper-bottom ballast cars, with 82 cars per train for the work, north of Vicksburg and 16 cars for the work south of that point.

On the change of grade south from Vicksburg the alignment has been improved by partial relocation. This throws the line back along the foothills, eliminating stretches of old fills subject to wave wash during high water. The new work starts 4 miles below Vicksburg and continues for 17 miles, being in intermittent stretches which aggregate 12 miles in length.

This improvement has reduced the length of line by 0.32 mile and eliminated 233° of curvature. The maximum grade is 0.5% and the maximum curves are 2°. On the remaining 5 miles the grade is raised on the old alignment, following the methods previously described.

Improvement of this 17-mile section was authorized in July, 1916, and begun in August. The grading was completed last August. The cost of grading and bridge work was $600,000, exclusive of the Big Black River bridge, which cost $170,000.

Grading on the relocation work was done by the H. W. Nelson Co., Chicago. The construction plant comprised three steam shovels, 75 wood dump cars of 12-yd. and eight of 16-yd. capacity, a steel spreader car, a wood spreader car, two pumping plants and tanks, and a water distilling plant. From four to eight 60-ton locomotives were rented from the railway company. Night and day shifts were operated for part of the time. Track, trestle and culvert work in connection with the grading was done by the railway forces.

All grade crossings of public roads have been avoided for 13 miles on the new line by the construction of two subways, an overhead bridge and a mile of road alteration.

The abrupt rise of the ground on the new sections of line caused considerable difficulty at three points, grades as steep as 10% being operated by the dump-car trains in reaching the shovels at the upper lifts. In several places the excavation struck a blue marl stratum about 6 ft. above the grade line. This gave trouble, as it could not support the load of the upper strata of clay. In one case the grade line was raised to the top of the marl stratum, but elsewhere the cuts were widened until the angle of repose of the overlying material had been reached.

Overflow of the bottom lands of the Big Black River by a high-water stage in the winter of 1916-17 caused the failure of a framed-bent trestle used in making the new fill. This necessitated the construction of a temporary pile trestle, the piles for which were driven by a creeping piledriver (mounted on rollers) while the water was at its high stage. This is shown above.

CREEPING PILEDRIVER CLOSES WASHOUT GAP IN TEMPORARY TRESTLE ACROSS BIG BLACK BOTTOMS

In this 32-ft. fill about 4 ft. of subsidence and 10% shrinkage of material occurred during the overflow. As 3000 ft. of the new embankment has not yet sustained an overflow period, the old line will be kept in condition for service until the next flood. This will provide for traffic in case of excessive shrinkage of the new fill.

The most important structure on the work is the bridge over the Big Black River, which has six plate-girder spans of 75 ft. carried by reinforced-concrete piers and abutments. To meet requirements for a navigation opening, one of the spans is provided with a lifting truss designed by the Strauss Bascule Bridge Co. This is operated by hand.

These extensive improvements were designed and carried out under the direction of A. S. Baldwin, chief engineer of the Illinois Central R.R. M. P. Black was assistant engineer in direct charge of the work.

Commission for Clarksburg, W. Va.

The commission form of municipal government was adopted by Clarksburg, W. Va., on Nov. 6, by a vote of 2852 for and 760 against. The new charter will bring four suburban towns into the city, making Clarksburg the third largest city in West Virginia.

As a Contractor Sees New York State's Road Situation

State Highway Commission's Methods Should Be Changed, It Is Contended, To Meet New and Unforeseen Conditions

By Dana W. Robbins

Of Dana W. Robbins, Inc., Engineers and Constructors, Utica, N. Y.

BY THE closing of the season and by the exigencies of war, the curtain has been rung down on New York State road work. It will stay down, regardless of the war situation, until there is a change of methods or until a new group of contractors is found, willing to contribute bountifully to the public good. Three-quarters of those engaged in the work during the past few years—and there have been over two hundred—have ceased to be active. Most of these are known to have been in financial difficulties. The work as a business proposition is in general disrepute among the banks, bonding houses and supply firms of the state.

Numerous reasons for these failures have been ascribed, including one by an official of the State Highway Commission to the effect that the contractors "lacked imagination." It should be stated that the contractors, generally, regard the present officials of the commission as the most able who have ever directed the highway work; and there is full realization of the fact that the highway law gives the commission little latitude in many directions. Also, many of the oldest and best road-building firms in the state, about whose ability there was no question, were among those which dropped out. To them, and to those who remain, there will occur a number of causes leading up to the present situation which are far from "imaginative."

Cost Estimates in Need of Revision

First: The highway commission, when preparing preliminary estimates, fixes the maximum price which can be obtained for doing the work. Contractors can take work at this price or go out of business with a large loss on plant investment. In the past these estimates have been fair, and bids have been 20 to 30% under them at times. In the rising markets of the past few months, however, the estimates have entirely failed to keep pace, as an examination of prices and comparison with labor, team and equipment costs will show. When engineers have become accustomed to certain unit prices, or costs per mile, it requires considerable mental elasticity to make up a proper estimate at this time, even if the data are at hand. Also, it requires considerable courage to place one of these estimates before a county board of supervisors. Nevertheless, when labor has virtually doubled in cost and lost fully 50% in efficiency it is evident that old ideas as to road costs must go.

Second: The contract and specifications now in use are the cumulative result of the efforts of eight or ten successive highway régimes, each of which, quite naturally, thought of a great many things the contractor must or must not do. What they overlooked the Attorney-General or the Comptroller supplied. Therefore, in signing a contract the "contractor agrees" to the extent of some 20 articles, one of which makes the standard specifications of 85 pages a part of the contract. The "State Commission of Highways agrees," in two brief articles, to pay for the work—only, however, under the numerous conditions mentioned in the next five articles.

There are many pitfalls for the unwary in the whole work of 116 pages. For instance, should a flood wash away a mile of finished road before the guard-rail is painted and the contract officially "completed," the loss is entirely the contractors. If the damage results from the failure of a new culvert to take the flow, the situation is unchanged, except that some time in the future the contractor may be able to recover in the Court of Claims. The damage cannot be paid for in any other way, regardless of the state's responsibility.

The Contractor's Hazard

Or possibly a note on the plans of a road states that stone from a ledge at a certain station has been tested and found acceptable for use in macadam. That would appear to be quite definite and final—but it is not. The commission has reserved the right to reject this at any time (which is proper), but the contractor shall have "no claim for increased payment" and must furnish stone from other sources of supply, which, of course, may be miles away.

On a road let in 1915 local top-course macadam was estimated at $3.75 per cubic yard and was bid at less. Before any top was laid the commission rejected a source of supply indicated on the plans as acceptable. The firm defaulted on the contract and the commission prepared a new estimate for completion in which top-course macadam appeared at $6.60 per cubic yard under the new requirements. In other words, the matter of $2.85 per cubic yard, or $15,000 on one item, was a hazard the contractor should have taken into account when he bid! It is idle to consider the increased cost of work let under such indefinite information, for the reason that the engineer's estimates are based on the accuracy of the first information, and any contractor making allowance for rejections could never get any work.

The matter of stone supply does not work both ways. On one contract "imported limestone" was called for. The contractor located a limestone outcrop within traction-hauling distance of the work and the stone passed all required tests. It could not be used, however, because "imported" means brought by "common carier." This decision was sustained in court.

A note on the plans to the effect that materials "may be from local sources" is held, not to give permission for their use, but to mean that they *may* be used if they pass tests to be made later on; the emphasis apparently being on the "may." Should the later tests result in the rejection of all local materials the contractor must import them without additional compensation.

The cases mentioned are but a few of those which have resulted in abandoned contracts and claims against the state. In the matter of recovery in the Court of Claims the contractors appear to be having considerable success, and this fact should have much weight in deciding upon changes which will make the claims unnecessary and will bring relief to the contractor when he needs it, rather than two years after he has been

forced out of business. Changes in the law will be necessary in some cases. For instance, the voluminous specifications and contract are silent about war, riot, flood, etc., the "Act-of-God" clause not being "among those present." As a result, the official position of the commission is that no unusual situation exists today.

Priority orders, draft laws, and $10 per day wages at cantonments and munition plants are, so it would seem, more hazards which the contractor assumed. Therefore, when he can make no further move of any kind, the commission will cancel his contract and retain any money due, as per articles 10 and 11 of the "contractor agrees." This will eliminate the contractor, but up to date has not seemed to expedite the construction work, for the bonding companies and the commission's own forces seem to be having troubles also. Can it be that they, too, "lack imagination?"

Steel Sheet Piling Repairs Pier at San Juan, P. R.

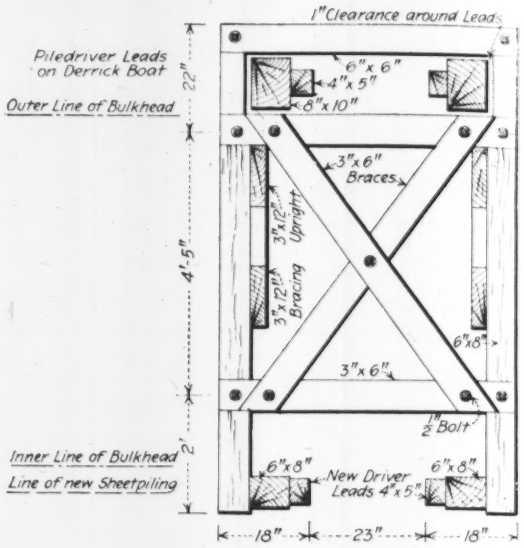
Floating Driver with Offset Leads Places Coffer Behind Old Bulkhead—Rat-Proof Floor of Plank on Broken Stone

SETTLEMENT of a large steamship pier at San Juan, P. R., necessitated repair to the substructure and superstructure. The work included an inclosure of steel sheet piling, jacking up the columns and trusses, and laying a timber floor on a stone fill. The repairs were designed by H. C. De Lano, chief engineer of the Harbor Board. Construction was carried out under the supervision of Earl K. Burton, of San Juan, acting as consulting engineer for the New York & Porto Rico Steamship Company.

The pier (known as the San Antonio Co.'s pier) is 255 x 290 ft., with a one-story steel shed or superstructure divided into three sections or spans. It was built, about 12 years ago, as a solid fill retained by a bulkhead of timber piles and sheet piling. The superstructure was built on this fill, its columns being supported on small wood piles. In recent years there has been continual settlement of the fill due to the soft mud substratum, and repeated filling has been necessary to bring the floor to its proper level. The columns settled appreciably, some as much as 24 in., and as a result the steel roof trusses were all out of line. These columns were jacked up and heavier foundations were put under them.

PILEDRIVER HAS TEMPORARY LEADS OUTSIDE OF MAIN LEADS

Driving the steel sheet piling by means of a hammer in temporary extension leads in front of the main leads of a floating piledriver was a novel method employed for driving this sheeting inside the bulkhead line. The old bulkhead consists of a row of wood sheet piling which is braced on the outside by round wood piles spaced 4 ft. c. to c. Exterior batter piles brace the entire bulkhead and have the same spacing as the vertical piles. At certain places the sheet piling had deteriorated so badly as to permit the fill behind the bulkhead to be washed away, and it was found necessary to stop these breaks by means of steel sheet piling.



PLAN OF FRAME FORMING TEMPORARY EXTENSION LEADS FOR PILEDRIVER

The only plant available was a derrick boat belonging to the San Antonio Company. As it was necessary to drive the piles at a distance of 6 ft. from the outer line of the bulkhead, a frame was constructed to fit against the leads of the piledriver mounted on the boat, and thus form new leads in advance of the latter. The 2700-lb. hammer was then placed in the new leads and operated in the usual way.

The new frame was so constructed that it could slide on the old leads, being raised or lowered by means of a second hoisting cable attached to the top of the frame. Thus the frame could be lifted free from the bulkhead, the derrick boat towed to its new position and the frame then dropped back into place. It was then secured to the bulkhead while the piles were being driven. This construction is clearly shown in the accompanying drawing and view.

A further advantage of this frame was in the driving of the sheet piling at locations where it was impossible to anchor the derrick boat directly against the old bulkhead—for instance, behind a pile dolphin in the stream, 8 to 10 ft. from the bulkhead. In such cases the frame was placed in its correct position over the bulkhead and braced in all four directions by cables from the top. The derrick boat was anchored to the dolphin and the piles were driven as before.

No floor had been placed over the old fill, but loose boards were used as dunnage for the cargo, these being placed and removed as necessary. Considerable settle-

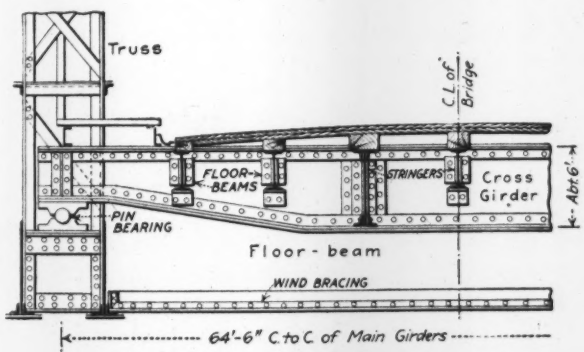
ment of the surface has resulted, some parts of the old earth fill having settled as much as 5 ft., necessitating a large amount of filling in order to keep the floor at its required level. With such a floor, extra labor for trucking cargo was necessary, in addition to the loss of a considerable amount of cargo destroyed by rats.

Owing to the character of the foundation, the fill will always be subject to some settlement, and in order to obtain a floor which would allow easy trucking, and at the same time be rat-proof, it was decided to construct a plank floor on a stone fill. A wooden floor was considered more advisable than concrete because, in case of settlement, the planks could be removed, more fill placed, and the floor replaced. With a concrete floor, the expense of tearing out the slab and replacing it with new concrete would have been excessive.

For building the new floor, the operation consisted of leveling the earth fill and spreading a layer of broken stone 8 in. thick, which was packed to 6 in. by rolling. Before the stone was rolled, creosoted sleepers 4 x 6 in. were embedded so that their tops were level with the top of the packed stone. These were spaced 4 ft. c. to c. On top of these sleepers was placed a floor of 2 x 12-in. yellow pine plank with tight joints and loosely nailed to the sleepers so as to be removed with ease. Care was used to leave no space between the stone and the planking, to make it impossible for rats to get under the floor.

Bridge Floor-Beams Have Pin Bearings

FLEXIBLE connection of floor-beams to the trusses is the feature of a through-truss highway bridge in Holland, built under the direction of the Dutch State Railways. The floor-beams are fish-belly plate girders, with their ends projecting into the trusses and fitted



FLEXIBLE END-BEARINGS FOR BRIDGE FLOOR-BEAMS

with shoes. These shoes rest upon bearing-pins in similar shoes seated in the bottom chord.

This construction, shown in the accompanying drawing, was illustrated recently in *The Engineer*, of London. No details were given. The brief article stated that attempts have been made to overcome the disadvantage of fixing the ends of floor-beams "but without much success as yet." It was stated that a serious disadvantage, in the case named, was the weakening of the bridge laterally, owing to the wind bracing not being connected to the floor-beams, and to the fact that the latter give no support to the trusses.

Special Forms Facilitate Concreting of Viaduct Deck Slab

IN CONSTRUCTING the reinforced-concrete deck slab of the High Line viaduct of the Kansas City Terminal Ry., at Kansas City, Kans., D. Munro is using a special sectional form for the cantilevered edge of the slab. This form can be erected and taken down very quickly, and gives excellent alignment of the slab. It was designed by W. A. Keene, the contractor's engineer.

As shown by the sketch, the form lagging is carried by cantilever frames having a 2 x 6 upright which seats against the web-plate of the outer track-stringer. A 4 x 6-in. wale bearing against the batter brace is tied back to the stiffeners of the stringer by eye-bolts, and thus holds the form in place. There is one bolt at each stiffener—about every 4 ft. For vertical adjustment and to bind the form in place, the upright is made a trifle short and wedges are driven between its foot and the stringer flange.

One form section is 8 ft. long, and has four frames spaced 2 ft. The lagging extends from the center line of one end frame to 2 ft. beyond the other end frame, so that adjoining sections of lagging meet over a frame. By tacking down the lagging that laps over this frame from the adjoining section, the form sections are held true and a tight joint is obtained. The 4 x 6 wale by which the frames are held in is 16 ft. long, and is placed so as to break joint with the form sections, which helps to assure true alignment of the sections.

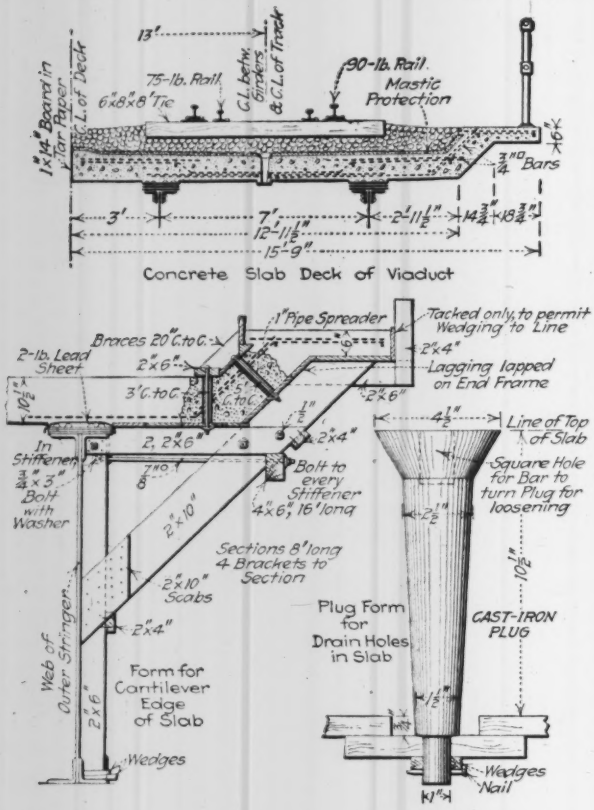
An inside form is required, to shape the curb of the slab. Its construction and manner of support are fully shown by the sketch. Care must be taken to let no concrete work up above the bottom of the 2 x 6 on which this inside form is built; otherwise the form will not strip out easily.

The vertical boards at inner and outer edges of the coping are tacked lightly to the frame members, instead of being nailed securely. Should they not line up accurately, where form sections join, they can be pried loose and wedged into line.

The deck is double-track, and is carried by four lines of plate-girder stringers. The slab is cut by a longitudinal joint on the center line, to forestall cracking due to one-sided deflection under load on one track only. This joint was formed by a 1 x 14-in. board, wrapped with tar paper and set on edge on the center line. The upper edge of the board supports one end of the screed or templet used to shape the floor; the other end of the screed rides on the 2 x 6-in. base strip of the curb form.

Each half of the deck is troughed slightly, draining to the track center-line. Here are located drain-holes at 5-ft. spacing. To form these holes, cast-iron taper plugs are used (see sketch). They seat on a board under a 4-in. square hole in the slab lagging, which hole forms the drip projection around the bottom of the hole. The plug is held firm by a 1-in. stem projecting down through this board, a nail through the stem, and wedges driven between nail and board. By pulling out the wedges and removing the nail, the plug is left free, and can be loosened in the concrete and lifted out by a hooked lever fitting a square hole in the top of the plug.

There are about 7500 lin.ft. of this deck slab, 31½ ft.



TIME-SAVING FORM DETAILS USED IN BUILDING REINFORCED DECK SLAB OF VIADUCT

wide over all, and 10½ in. thick, running 1.1 cu.yd. concrete per ft. Forms have been built for a 500-ft. length of slab. The contractor now places about 100 lin.ft. of deck per day, when everything is running smoothly. This includes the time required for moving the plant. In warm weather he expects to make 180 to 200 ft. per day. The work has just been started; probably 1500 ft. of deck can be completed before work is stopped by cold weather.

The concreting plant consists of a hoist, tower and mixer mounted on skids 32 ft. long, and set alongside the viaduct at the middle of the floor section to be concreted. This plant can be moved forward to new position in about 20 minutes.

The work is under the direction of J. V. Hanna, chief engineer, and Geo. E. Tebbetts, bridge engineer of the Kansas City Terminal Railway.

Cleveland Sewer Needs Declared Urgent by Local Engineers

ENGINEERS took a hand in advocating the passage of a $3,000,000 bond issue at the recent election in Cleveland, Ohio. On account of the backward condition of the sewer system, city officials made an effort to bring the importance of the sewer needs to the attention of the engineering element among the public, represented by the Cleveland Engineering Society.

Some time prior to the election the society appointed a special committee to investigate and report on the sewer situation, so that the importance of the sewer bond issue might be properly gaged. The committee was made up of men who were specially qualified for the purpose by familiarity with the general sewerage conditions of the city. While the subject was under consideration, Robert Hoffmann, chief engineer of the city, read a paper at a meeting of the society giving facts on the sewer conditions. Following this, the committee presented a report favorable to the sewer bonds, and this report was unanimously approved.

The need for city expenditure in connection with sewers arises from the fact that the city as a whole must pay the cost of sewers under street intersections, at least 2% of the remaining cost of local sewers, and the excess cost of any branch or main sewer over the cost of a local sewer.

The city's share of about 100 local sewer projects now under way will amount to nearly a million dollars, and of main sewer projects more than double this sum. Provision must also be made for sewering recently annexed portions of the city and partly developed land within the city, and for rebuilding several miles of sewer that is either too small or too shallow.

Flooding from inadequate sewerage is not infrequent in Cleveland. The city has about 17 miles of street and less than 15 miles of sewer per square mile; to equalize sewer and street mileage requires the construction of 106 miles of additional sewer in the entire city. Sewer expenditures have been exceedingly erratic in the past. The annual expenditure from 1890 to 1916 ranged from a maximum of 25c. (1891) to a minimum of 4c. (1910) per $100 of taxable valuation. The 1916 expenditure was 7c. per $100. The average expenditure per year during the last ten years was less than 9c. per $100.

Consideration was given to the fact that the authorization of bonds does not mean that all the bonds must be issued, or all the work undertaken at once. With the authorization, however, a definite program is in prospect. The problem can be approached in a comprehensive and scientific manner, and the work properly distributed over a number of years.

The society's endorsement of the sewer bonds was fully reported in the news columns of the Cleveland daily papers. At the election all the bond issues asked for—including $5,000,000 in addition to the sewer bonds—were approved by the voters.

Effect of Priority Order No. 2 on Massachusetts Road Work

The following statement regarding Priority Order No. 2 has been received from Arthur W. Dean, chief engineer, Massachusetts Highway Commission:

"This embargo makes necessary the shutting down of a number of partially completed contracts. We have been able to get enough ballast cars to ship sufficient stone to make these roads passable for the winter. The effect on future work in Massachusetts will be to permit road construction only in localities where a good quality of local stone can be secured or where there is gravel or other material suitable for making bituminous concrete or cement concrete surfaces."

Activated-Sludge Tests Made by California Cities

Process Competes with Imhoff Tanks and Sprinkling Filters To Produce Effluent for Use on Joint Sewage Farm

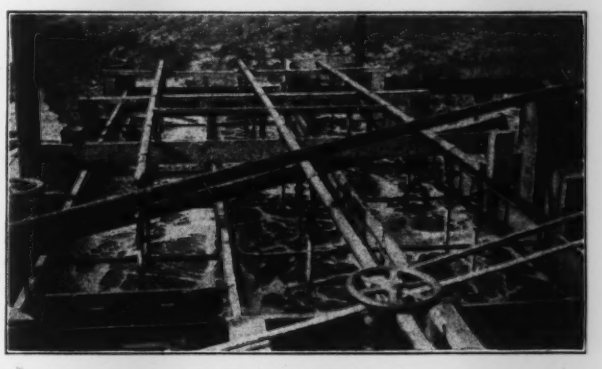
WHAT may be termed competitive tests to determine whether the activated-sludge process or a combination of Imhoff tanks and sprinkling filters will produce the most satisfactory effluent for application to the joint sewage farm proposed for Pasadena, South Pasadena, and Alhambra are being made at Pasadena under the direction of a board consisting of the city engineers of the three municipalities, headed by R. V. Orbison, of Pasadena. The other members of the board are John MacMillan, of South Pasadena, and Charles E. Hewes, of Alhambra. A report reviewing the activated-sludge experiments from Jan. 29, when the plant was put in operation, until Sept. 1, and touching lightly on the Imhoff tank tests, was submitted recently to the authorities of the three cities. From this report and notes made at the plant by a member of the editorial staff of *Engineering News-Record* this article has been prepared.

The activated-sludge plant consists of a diverting box, with a weir and a hook gage, a rag picker, an aërating tank, two settling tanks, a sludge re-aërating tank, a No. 1 Nash hydro-turbine blower to provide the air supply, a venturi air meter, an air lift used to raise the sludge from the settling to the sludge re-aërating tank, and a centrifugal pump for lifting excess sludge from either of the two tanks just named. A small laboratory is close at hand.

SPIKES EXTENDING THROUGH PERFORATED PLANK REMOVE RAGS FROM SEWAGE

The rag picker was installed to catch any rags, paper, or waste which pass over the weir in the diverting box. It was designed by E. P. Dewey, assistant city engineer of Pasadena, who also designed the individual cast-iron filtros plate holder mentioned later on. The rag picker, which is in duplicate, consists of spikes set 2 in. apart, staggered, in a 1 x 12-ft. plank and protruding 2 in. through holes in a second plank. To remove the rags, the upper plank is raised by means of levers until flush with the top of the spikes, taking the rags with it, which are then easily shoveled off. Cleaning two or three times a day is necessary.

The aërating tank is 9 x 20 ft. in plan, by 10 ft. deep. Two lengthwise partitions give 60 ft. of continuous



THE SURFACE OF THE AERATING TANK SHOWS GOOD AIR DISTRIBUTION BY FILTROS PLATES

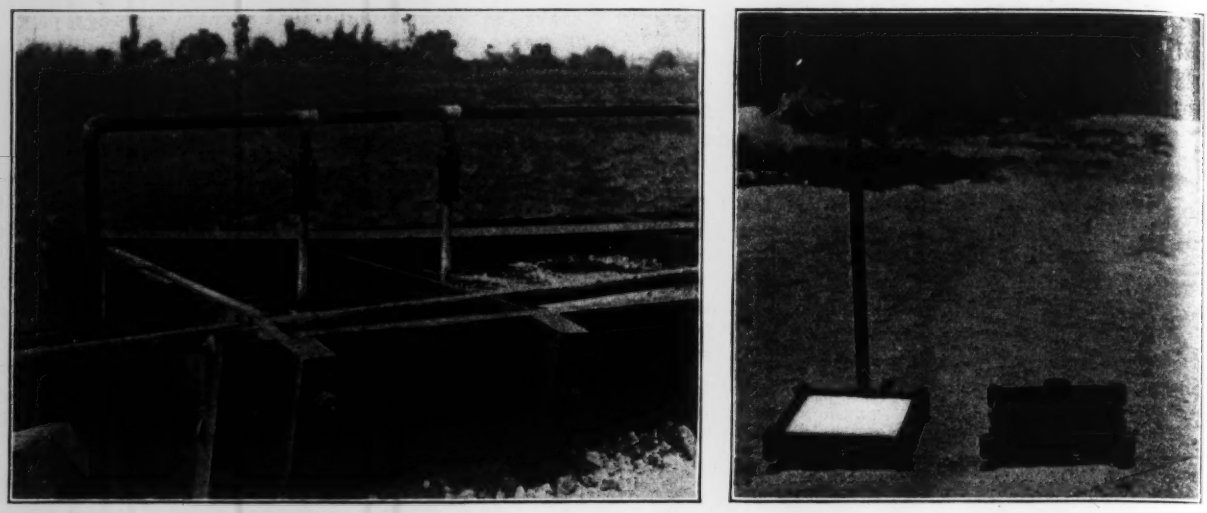
channel in which are 21 filtros plates, giving a ratio of 1 to 8.5 between diffusion and tank area. After the tank was built the board of engineers was informed that the sludge would build up between each plate, and although various tests had not shown any septic sludge, yet to be on the safe side wedges were installed crosswise in the channels between the plates.

Each filtros plate is set in a separate cast-iron frame, on the assumption that only one will have to be replaced at a time. Plug cocks and Dayton couplings at the top of each vertical air pipe permit disconnection and easy removal of any plate without emptying the tank or even stopping its operation.

Two settling tanks were built, but only one was in use at the time of the report. A 12-in. trough and baffle wall are provided for even distribution of the aërated sewage in the tank. Experience showed that the quick-settling aërated sewage soon filled the distributing trough, which was level. Settling was prevented by laying a 1-in. air pipe, with $\frac{1}{32}$-in. perforation, in the bottom of the trough.

The first sludge re-aërating tank was 6 x 6 ft. in plan at the top, 2 x 2 ft. at the bottom and 8 ft. deep, with only one filtros plate. As this was too small for "later needs," it was rebuilt 6 x 12 and 2 x 12 ft. in top and bottom plan and with an effective depth of 10 ft., with four filtros plates. The plates are set in individual frames and are separated by wedges, as in the aëration tank.

From Jan. 29 to Mar. 16 the aërating tank was operated on the fill-and-draw plan for the purpose of building up activated sludge. From Mar. 17 to June 27 the tank was run on the continuous-flow plan. It was found that four hours of aëration, using 1 cu.ft. of air per



PLUG COCKS AND DAYTON COUPLINGS ON VERTICAL AIR PIPES PERMIT REMOVAL OF INDIVIDUAL FILTROS PLATES WITHOUT SHUTTING DOWN WHOLE TANK

The large view shows a part of the sludge re-aërating tank. The sewage aërating or activation tanks are equipped in the same way

gal. of sewage treated per min., with 10 to 20% of activated sludge, followed by 30 min. of sedimentation, would produce a non-putrescible effluent, containing nitrites, with a bacterial reduction of 96 to 99.6%. On cutting the aëration period to two hours, it was found that the sludge was not properly activated and that the final effluent was very poor. The sludge tank was therefore enlarged, as described, to give a re-aërating period of about three hours. A grit chamber was also provided, to remove sand, coffee grounds, etc., but this was abandoned because some of the material in the grit chamber would become septic in spite of several cleanings a day.

On July 23 the plant was again put in service. For two days the fill-and-draw method was used, then the continuous-flow plan. In five days the following results were obtained: Free ammonia, 32.94; albuminoid ammonia, 1.976; nitrites, 3.33; chlorine, 100.08; relative stability at 37° C., 99; turbidity, 30. At this time 2.9 cu.ft. of air per gal. of sewage per min. was being used, but within a few days the air supply was reduced to 1.75 cu.ft., while on Aug. 29 it was back to the early figure of 1 cu.ft. per min.

Having shown that good results can be obtained with 1 cu.ft. of air for 4 hours, hereafter various air volumes and aërating periods will be tested.

The tests thus far indicate that with albuminoid ammonia at less than 2 p.p.m. good nitrification may be looked for on a relative stability which will nearly always be 99+; but if the albuminoid ammonia goes to say 2.30 p.p.m., then "the color will 'shoot' in the incubator before the end of 10 days."

No tests of the fertilizing value of the sludge will be made until aëration questions have been answered.

Sludge drying on open beds gives rise to odors that make that method of dewatering impossible. Even when the activated-sludge was mixed with Imhoff sludge and put on an open bed the odor was so bad that a chemical deodorizer had to be used.

Tests of an activated-sludge plant installed by A. M. Brosius, in which a diffuser wheel and foam chamber are designed to take the place of compressed air and filtros plates, had not yielded conclusive results up to Sept. 1, owing to several plant breakdowns. A Brosius plant at Hermosa Beach, Calif., was described in *Engineering News* of Nov. 9, 1916, page 890.

The cost of the testing plant and laboratory up to Aug. 17, including both construction and operation, had been $6462. Apparently this did not include the Imhoff tank and sprinkling filters. Continuation of the tests for another year is proposed.

The daily flow from the three cities is about 3,000,000 gal. normal and 7,500,000 gal. maximum. At the test plant, 50,000 gal. of sewage are being handled daily on an area of 267 sq.ft., or about 8,000,000 gal. an acre, on a 4-hour aërating period basis. It is estimated that activated-sludge plants will not exceed by more than 60% the cost of Imhoff tanks and that by eliminating the need for sprinkling filters the activated-sludge process would save at least 50% on the construction cost of Imhoff tanks, sprinkling filters, secondary settling tanks and sludge-drying beds.

All-American Canal for Imperial Valley

That an all-American canal could be built to bring water into the Imperial Valley, California, so that the 400,000 or 500,000 acres of land reclaimed by the new project would bear easily the cost of it, is the belief expressed by J. F. Richardson, of the U. S. Reclamation Service. Mr. Richardson recently completed a three weeks' trip over the proposed route of the canal. A 12- to 15-mile timber-lined tunnel, or inverted siphon, to carry the water through sand hills would be more practical than an open cut, it is believed, as the soil formation at a depth of approximately 40 ft. is excellent for tunneling.

This project has been under consideration for some time and a number of studies have been made on the subject. The Imperial Laguna Water Co. is surveying the route for the canal, which it is hoped can be built so as to reclaim the mesa lands under a contract recently entered into with the Department of the Interior.

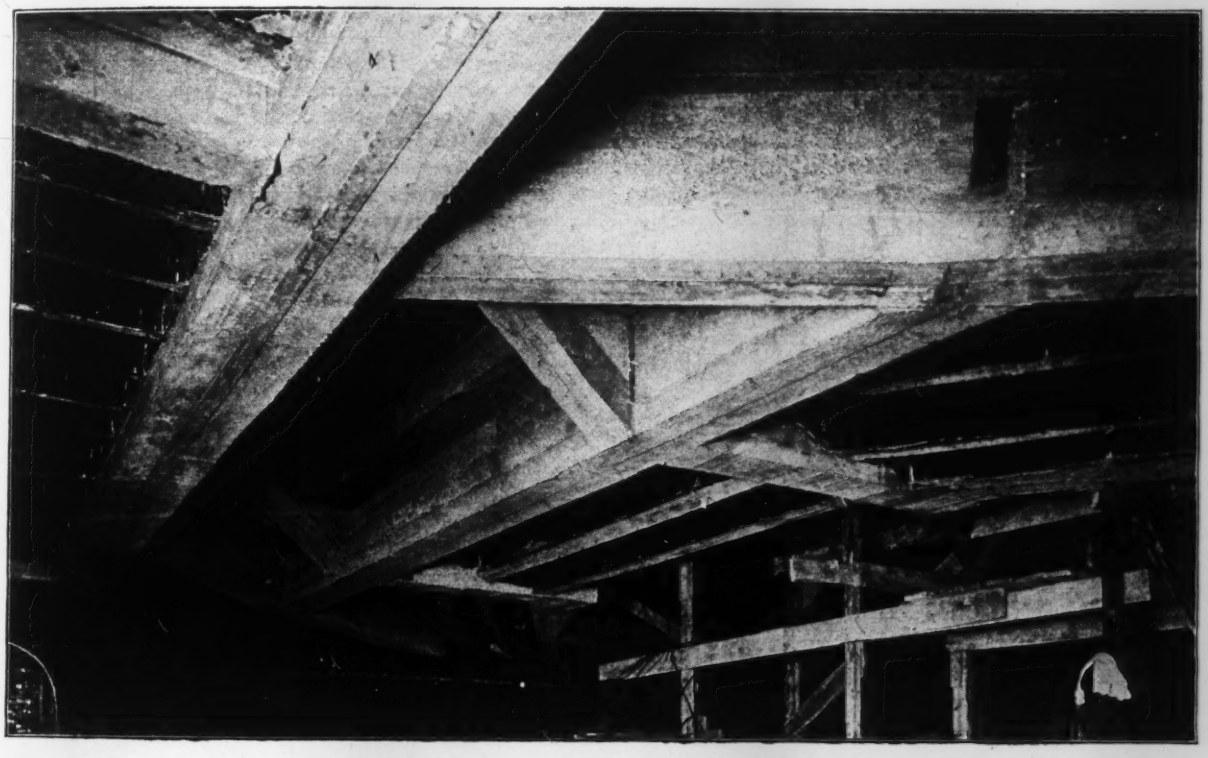
Balcony of Concrete Theater Has Novel Framing

Diagonal Beams Between 57-Foot Fulcrum Girder and Wall Reduce Cantilever Moments—Cinder-Concrete Steps on Thin Balcony Floors Reduce Loads

THE war has brought about a scarcity of structural steel, but so far, at least, has not caused any pronounced restriction of the construction of new theaters in New York City. One of the latest, the Vanderbilt, on West 48th St., is being built of reinforced concrete because of the difficulty of getting steel, and the engineer, Elwyn E. Seelye, of New York City, has introduced in the structural design several novelties which reduce the amount of material and consequently the cost.

The design of a theater in reinforced concrete presents a problem which is susceptible of several different solutions. The balcony steps may be formed of structural concrete or they may be merely cinder concrete fill on top of the structural concrete. The balcony framing may be formed by the use of cantilevers with the main balcony girder as a fulcrum, or a system of diagonal beams resting on the main balcony girder may be used to eliminate the large cantilevers. The general construction of the reinforced concrete may be beam-and-slab, terra cotta tile and concrete joists, or metal tile and concrete joists.

In this theater the balcony has cinder concrete banks for the chairs and steps, resting on a thin reinforced-concrete floor made up of a slab-and-beam construction poured in metal box forms, which in turn ties into the reinforced-concrete girder frame. This frame has for its main member a deep transverse girder spanning between the wall columns. This main girder does not form a fulcrum for cantilevers as in the usual form of construction, and hence its moment is less because the load from the portion of the balcony in front of the main girder does not have to be balanced by an equal load from the portion of the balcony in the rear. In fact, none of the front portion of the balcony is carried by this girder directly, but it is carried by secondary framing consisting of small cantilevers, resting on a short-span fulcrum girder, which rest on two diagonal girders that in turn react at one end on the main girder and at the other on the wall. The result of this framing is to throw about one-half of the load into the wall, thus reducing the moment on the main girder.



LOOKING UP AT DIAGONAL GIRDER SYSTEM UNDER CONCRETE THEATER BALCONY—MAIN FULCRUM GIRDER RUNS FROM FOREGROUND AT LEFT, STAGE TOWARD RIGHT

The moment on the main girder is further reduced by the fact that the diagonal girders do not react on the main girder at the mid-point of its span. A comparison of this design with that of one with the usual cantilevers showed a reduction in moment in the main girder of about 20 per cent.

The general details of the theater structure are shown by the accompanying drawings. The building is 100 ft. long, 57 ft. wide at the front and 77 ft. at the stage, with one balcony and the orchestra floor, the latter

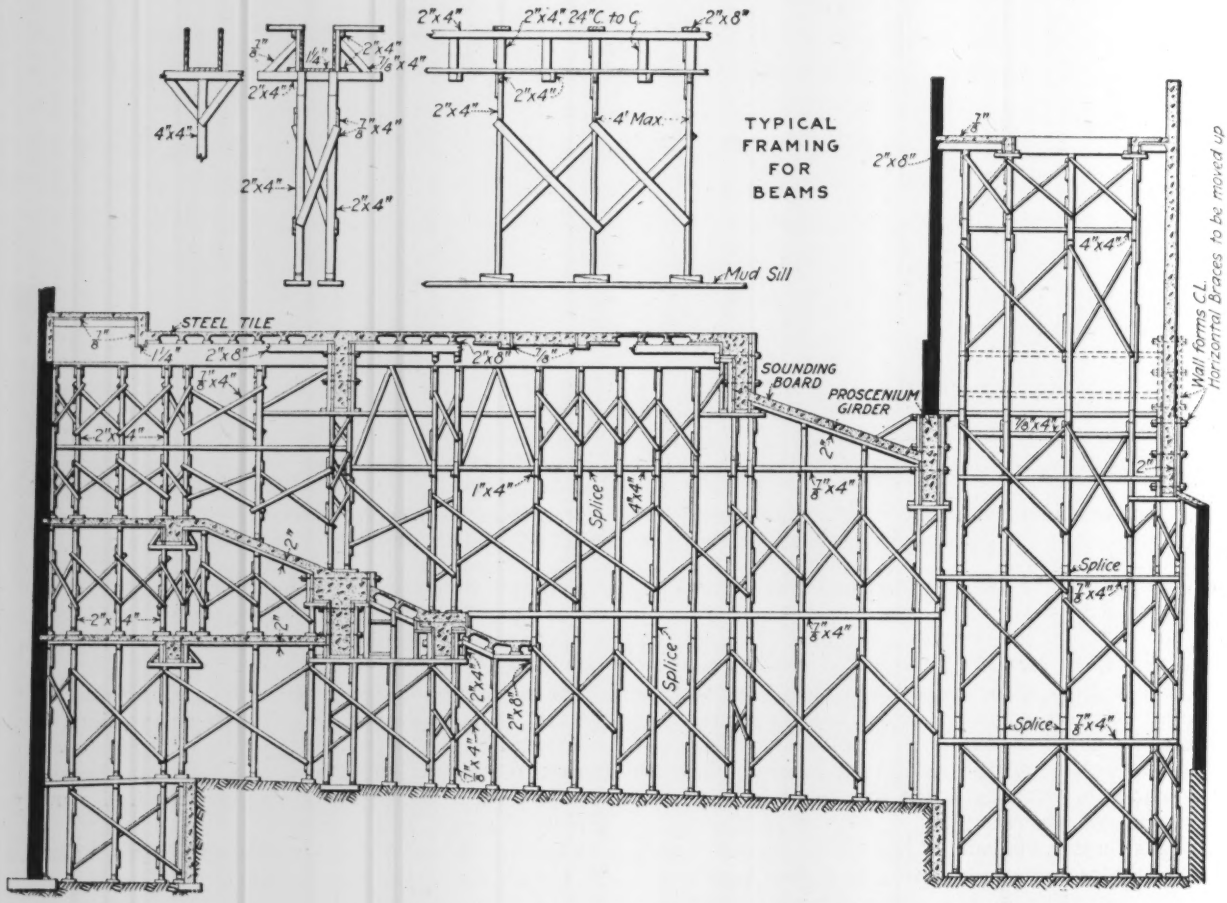
directly on the ground surface. The frame is of reinforced concrete, comprising wall columns, the balcony described in the foregoing paragraphs, stairways, and the stage section which has the usual equipment of dressing rooms and gridiron. The walls are of brick, including the extension of the proscenium wall above the auditorium roof. The roof is of concrete beam-and-slab construction, poured in metal box forms left in place, and framing into long transverse girders and longitudinal beams. The back wall is of special design, as described later in this article.

The main balcony girder is 56 ft. 2 in. in span and 7 ft. ½ in. deep. It is of T-beam section with a stem 22 in. wide and a flange 29 in. thick and varying in width from 4 ft. 6 in. at the middle to 20 in. at the support. A good deal of care was required in placing the steel so that the concrete would surround it thoroughly and develop proper bond, especially as the span of the girder was so great that the bars had to be spliced. The steel was centered in vertical rows and the stone used in the concrete to surround it was screened through a ½-in. mesh, to make sure that the aggregate would not get caught between the bars.

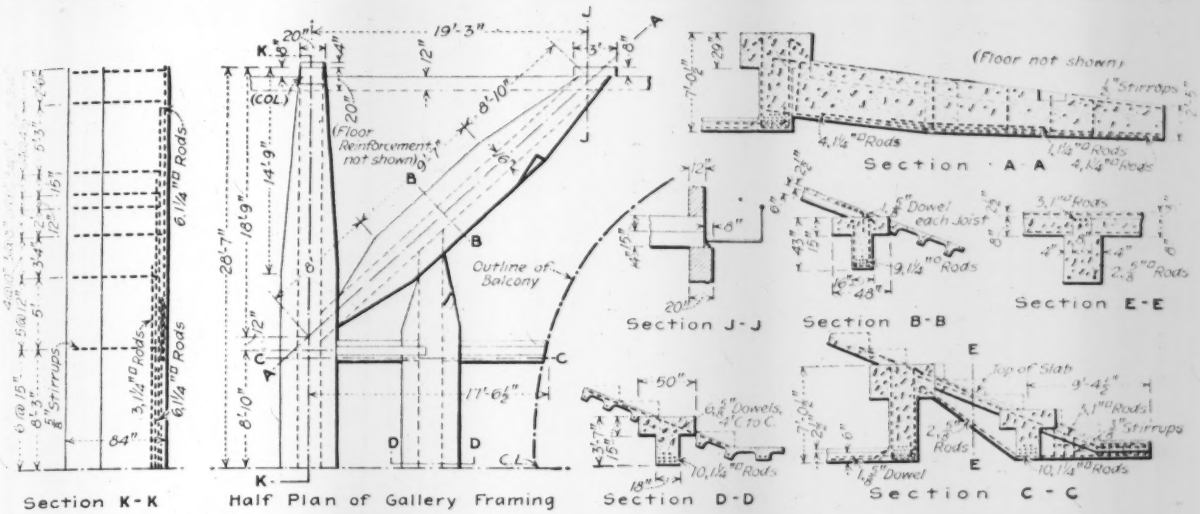
Some question was raised by the engineers representing the mortgagee as to the effect of the shrinkage of this girder on the columns supporting it. It was maintained that shrinkage would be sufficient to pull the columns together and cause high flexural stresses in the concrete. Measurements were taken on the columns before and after pouring, and no movement was discerned. The extreme deflection on the cantilevers when the forms were removed was about $\frac{3}{16}$ in. As to the shrinkage of the girder in its length, the designing engineer is very doubtful if such will occur in a reinforced girder. A plain girder, non-reinforced, would have a marked shrinkage. It is true that this girder was not reinforced in its T-flange but it was reinforced in its soffit and doubtless the compressive stresses due to flexure far more than neutralized any tensile stresses due to shrinkage in the T-flange.

The connection between the column and girder was poured as a part of the girder. That is, the column was poured up to the base of the girder, the column for the depth of the girder poured with the girder, and the upper part of the column next. Reinforcement for the girder extends well into the column. All columns are of rectangular section with vertical reinforcement tied together with rectangular hoops of ¼-in. wire on 12-in. centers.

The diagonal girders and the secondary transverse girder were also designed and built as T-beams with narrowing flanges toward the supports, but the longitudinal cantilevers are prismatic with indented upper sections to carry the floor joist. The floors are laid to the slope of the balcony and consist of transverse joist, made by pouring around steel box forms, and a 2½-in.



SECTION THROUGH CONCRETE THEATER BUILDING, SHOWING FORM LAYOUT AND CONCRETE SECTIONS



BALCONY IS CARRIED ON REINFORCED-CONCRETE GIRDERS FRAMED TO REDUCE CANTILEVER LOADINGS

slab. The steps are of cinder concrete, placed after the whole reinforced-concrete balcony was completed. It will be noted that the flanges of the main and secondary transverse girders each form one of the steps in the balcony.

The cinder concrete steps are built up of a lean mixture about equal to the ordinary cinder concrete fill between wood sleepers for wooden floors, being proportioned about 1 part cement to 2 parts sand to 10 parts of cinders. They are afterward finished with a cement and sand finish 1 in. thick composed of 1 part cement to 2 parts sand, similar to a sidewalk finish.

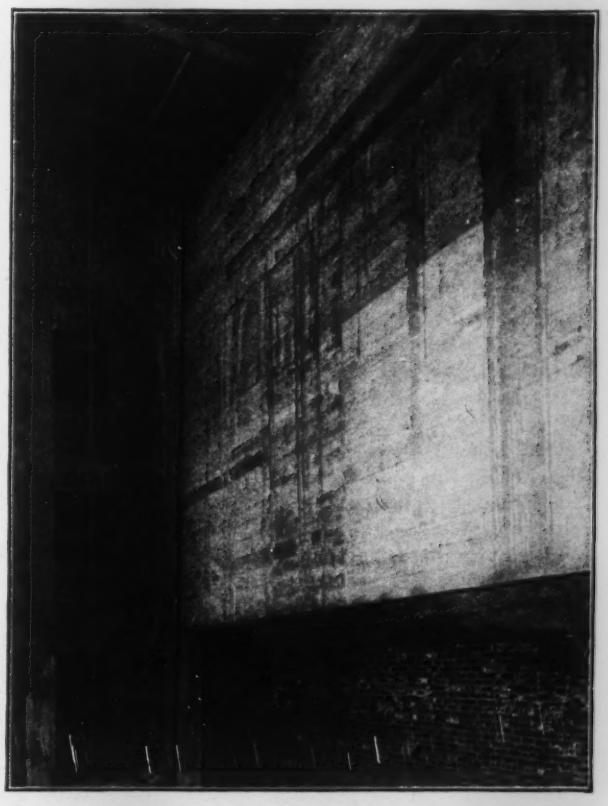
The diagonal girders were made of variable depths in order to clear the sight lines at their lower ends, hence the broken soffit lines shown in the drawing. All ceilings are suspended from the floors or roof, as the case may be.

The original design for the upper wall contemplated a 12-in. concrete wall merely reinforced at the bottom with tension steel and a light network of shrinkage steel throughout. This was modified at the request of the New York Building Department because of lack of precedent, and a girder of 13 ft. deep and 50 ft. span was designed, from which was suspended an 8 in. curtain wall of concrete, 16 ft. deep. Inasmuch as the 12-in. wall was braced laterally at the top by a reinforced-concrete roof slab, the designer feels that the original design would have been perfectly safe and it would have been somewhat more economical in steel and formwork. The girder as built is 12 in. wide at the bottom, spreading out to 30 in. at the top, is reinforced in the bottom with twelve 1-in. rods and hooped, as it were, with $\frac{3}{8}$-in. rods as shown in the detail. It frames into columns in the rear wall.

The space between the brick curtain wall and the upper concrete wall is covered with a sloping concrete slab. A similar sloping slab carries the sounding board connecting the lower part of a deep roof girder and the lower part of the proscenium girder. This latter girder is prismatic, spanning 37 ft. between columns. It is 16 in. wide and 7 ft. 10 in. deep. The slab covering the sounding board is 14 ft. 9 in. in clear span with a slope of about 2 on 1.

Details are shown of a reinforced-concrete stairway which is made up of broken-back slabs. Where the soffit is reëntrant, stirrups have been provided to prevent the steel from straightening out. It will be noted that in the lower slab, which has a horizontal span of some 20 ft., tile-and-joist construction was used in place of a solid slab. This was done to reduce the dead weight and consequently economize on reinforcing steel.

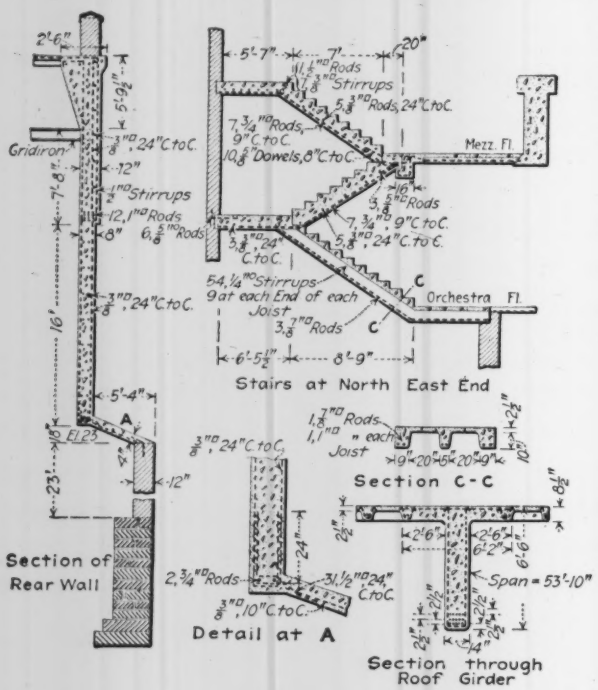
Another interesting detail is the back wall of the stage, shown in the drawings and in one of the views.



UPPER PART OF BACK STAGE WALL CARRIED FROM DEEP GIRDER

The building law required an alleyway court in the upper part of the rear of the building with an inset of 5 ft. 4 in. from the back stage wall, which is brick resting on a continuous footing wall.

The loadings for the balcony were as follows: Live-load, 100 lb. per sq.ft., 6 in. cinder fill, 36 lb. per sq.ft., tile-and-joist slab, 46 lb. per sq.ft. and suspended ceiling, 6 lb. per sq.ft. Total, 188 lb. per sq.ft. No attempt was made to allow for eccentricity in the columns. The deflection of the girder under full load produced flexural stress in the column which was computed but not allowed for, as the live load on the balcony required



SPECIAL DETAILS OF FRAMING IN REINFORCED-CONCRETE THEATER

by the building law was sufficiently excessive over actual loading conditions to compensate.

One of the drawings is a cross-section through the theater showing the form layout. These forms were designed carefully for the liquid load of the concrete. The reader will note that great care was used in lateral bracing, and also care was taken to have direct bearing on the ends of the upright rather than to rely on spiked fish plates to take load. This form plan also indicates the simplicity of the forms for the tile-and-joist construction, only beam bottoms being required. The forms were so constructed that they could be used as a scaffold for brickwork and also for the construction of the suspended ceiling. For the latter purpose a splice was placed in the uprights about 10 ft. below the roof, so that the upper tier of uprights could be removed after the concrete was set and a plank floor be laid at that level.

The reinforcing was the Slick mechanical bond bar furnished by the Berger Manufacturing Co., as was also the metal tile. The diagonal tension was resisted by stirrups exclusively, the main girder steel being straight and some of the bars being shorter than the full length for the sake of economy.

Not the least important part of construction consisted in the inspection. This included the usual precautions in regard to cement and the aggregate. All steel was carefully checked before the concreting operation and the placing and mixing of the concrete was watched continually. Forms were checked for strength before the concrete was poured. The inspector was a man trained in this type of work.

The architects for the Vanderbilt Theater were Pereira & De Rosa and the consulting engineer was Elwyn E. Seelye, who was responsible for the reinforced-concrete design and construction. The work was carried out by Isaac A. Hopper's Sons, Inc., contractors. All of these principals are of New York City.

Condition of Roads in English City Discussed by Engineer

City Surveyor Hadfield, of Sheffield, States That Maintenance Is Chief Work—Tar Spraying Commended

HIGHWAY work in Sheffield, England, for the fiscal year 1916-17, according to the report of W. J. Hadfield, city surveyor, was confined largely to maintenance and absolutely necessary works of renewal. Great attention was paid to maintenance, and every effort made to spend the money available in such a way as to minimize depreciation of the roads. During the years immediately prior to the war extensive schemes of highway reconstruction had been carried out—in particular many of the main roads were entirely resurfaced. Consequently the present reduction of expenditure has not been so seriously felt as otherwise would have been the case. Its principal effect is that surface improvements, such as the conversion of bowlder paving, are stopped. A summary of the Sheffield report, as given in *The Surveyor*, follows:

Some of the busy East End thoroughfares and the older wood-paved streets, it must be admitted, are falling below the usual standard, but they are still capable of carrying the traffic. In any case the number of workmen necessary to repair them permanently is not available, the committee have not the necessary funds, nor is it practicable to obtain the materials required.

It is not likely that the postponement of expenditure will lead to increased cost. A longer life is being obtained from the old paving than would have been the case under normal circumstances, and the chief disadvantage is that in such thoroughfares the traffic is having the use of less efficient road surfaces.

The reduction in capital expenditure during the last three financial years, as compared with the average capital expenditure for the five years before the war, amounts to nearly £60,000. By the end of the current financial year the reduction will be between £85,000 and £90,000.

City Surveyor Hadfield advises the committee that the expenditure of such a sum spread over several years would be sufficient to make up the leeway caused by the present suspension of capital expenditure.

This year's cost is extremely low for Sheffield, work-

ing out at £94 per mile, less than half the figure for the years immediately before the war.

War conditions are not entirely responsible for this reduction. Modern methods of road making have for some years past helped to reduce highway costs, and in this respect Sheffield compares favorably with many other highway authorities, whose general complaint, even before the war, was that costs were increasing.

Asphaltic Pavements

There are now sixteen streets in which lengths of asphaltic surface have been laid. The total area is about 15,000 sq.yd. Careful observations are being made, so that when highway operations on a larger scale are resumed a correct judgment may be formed as to the suitability of this type of pavement for more general adoption.

As far as can now be seen, it is likely to be more economical than wood blocks or granite setts, both of which are likely to remain very expensive for some time to come.

Wood blocks at present are practically unobtainable, but the situation was foreseen, and large purchases were made in the early stages of the war at prices which, compared with recent quotations, have effected a saving of at least £4000, besides securing sufficient materials to carry on at any rate until next year.

Clinker-Asphalt Paving

There has been one important introduction during the year, namely, a road surface which consists of carefully-graded destructor clinker mixed with bitumen or asphalt. This process has been patented by E. J. Lovegrove, borough engineer of Hornsey, London, and carried out by him on an extensive scale with great success.

A license has been obtained from the company which has the working of the patent, and test pieces have been laid in Attercliffe Common, Carbrook St., Carlisle St. and Weedon St. In Carbrook St. an area of over 1000 yd. has been resurfaced, the old macadam being retained as the foundation. In the other cases small areas only have been laid, in situations which will insure excellent tests. In Attercliffe Common, where there is a very heavy traffic, the material is laid right up to the tram rails—a severe condition; in Carlisle St. individual loads of from 50 to 100 tons pass over the trial piece, while in Weedon St. there is a heavy mixed traffic, including motor busses.

So far the results have fully justified expectations, and if this continues to be the case there will be available a cheap paving, more permanent than tar macadam, and therefore suitable for roads with traffic too heavy for the latter, at the same time less costly than setts or asphalt, and with the further advantage of utilizing surplus clinker from the destructor, which now has to be disposed of at considerable cost.

Tar-Macadam Roads

The increase in mileage of this form of paving from 60 to 63 miles is accounted for by the necessity of re-surfacing some of the worn-out waterbound roads.

An outstanding feature of highway work in Sheffield is the remarkable success of the tar-macadam roads, which are exceeding expectations both as to length of life and low cost of maintenance.

In particular, the roads paid for out of money lent by the Road Board may be quoted. The last instalment is due for repayment in October, 1918, and the state of these roads speaks for itself—they are nearly as good as when they were laid.

One of these roads—the Chesterfield—has withstood an immense amount of special traffic (connected with war undertakings), which has completely worn out adjoining waterbound roads laid at a later date. Another—Abbeydale—is carrying a considerable motor bus traffic (not in existence when the road was reconstructed) with very little detriment to the tar macadam.

Such work will more than pay for itself, besides being advantageous both to vehicular and pedestrian traffic.

Concrete Roads

The question of constructing roads with concrete surfaces is again being widely discussed, and thoroughfares of this character in other districts have been inspected. Considerable knowledge has been gained, but there is so far no convincing evidence that concrete roads pure and simple would be suitable for wide use in Sheffield. In view of probable restrictions upon the use of other road-making materials, however, it may be necessary to adopt this system to a greater extent than otherwise would be thought advisable.

Many of the asphaltic roads already laid in the city are practically of reinforced concrete, depending for their strength entirely upon the concrete, but having a thin wearing surface of asphalt.

An increased area has been tar-sprayed, or tar-painted. In this way many of the old waterbound roads, which otherwise would have needed reconstruction, have been kept in serviceable condition.

When first adopted, the tarring of road surfaces was looked upon chiefly as a remedy for the dust nuisance; it is now proved to be one of the most effective ways of securing economy in road maintenance, and has undoubtedly saved many roads which without this protection would have gone to pieces during the last two winters, when the weather conditions were particularly severe. The area tarred this year will exceed one million yards, and there are special reasons for pushing this work as much as possible during the present summer.

Simple Rule for Strength of Wooden Beams

By W. J. Howard
Detroit, Mich.

The safe uniform load for a wooden beam 1 in. thick, 10 in. in depth, 10 ft. in span, using an extreme-fiber stress of 1000 lb. per sq.in., is 1111 lb. The safe uniform load for any beam can be found very conveniently from this figure, since the safe load varies directly as the thickness of beam, as the square of the depth, as the fiber stress used, and inversely as the span length. With a 6 x 8-in. beam 16 ft. long and the timber such as to allow an extreme-fiber stress of 1400 lb. per sq.in. the safe uniform load would be:

$$6 \times \tfrac{64}{100} \times \tfrac{1400}{1000} \times \tfrac{10}{16} \times 1111 = 3733\ lb.$$

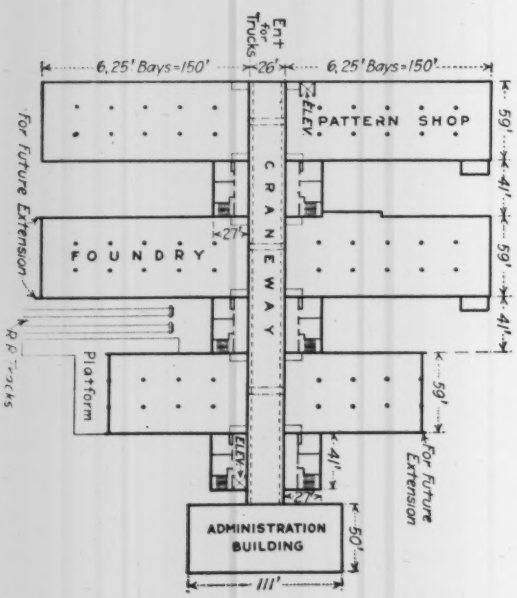
This is particularly useful to field engineers as they only need to keep in mind the safe load for one beam, a number easily remembered—1111 lb. For a concentrated load at center of span use one-half this value.

Unusual Factory Layout Designed to Simplify Operation

Concrete Building for Nathan Manufacturing Company at Flushing, L. I., Can Also Be Readily Enlarged or Changed

AN ARRANGEMENT of shops as wings to a central craneway which leads from an administration building and controls all the various parts of the plant has been adopted for the new factory of the Nathan Manufacturing Co. at Flushing, a part of the Long Island section of New York City. This layout is the most important detail in the fixed purpose of the designers to build a plant which would facilitate operations and most readily permit enlargement. In pursuance of this main idea, the elements of design and equipment were developed. The general layout of the main buildings and some minor details of the structure were described in the *Engineering Record*, Feb. 24, 1917, p. 309. Since then, the building has been completed and put into operation as a factory for the manufacture of various kinds of brass goods.

The structure is mainly of reinforced concrete, the floors being of the flat-slab type in spans of about 20 ft. square. The slab is of a round design, except that the drop head has been omitted. The walls throughout are also of reinforced-concrete, carrying steel sash of a maximum lighting area. The roof of the most of the structure is a concrete slab with Johns-Manville asbestos roofing, but over the foundry, as shown in one of the views, the span was so great as to require steel trusses. These trusses rest on concrete columns and carry a concrete roof, made up of 3-in. reinforced-concrete slabs spanning concrete girders cast around the I-beam purlins. A similar type of roof is used in the power house and in the garage. The roof trusses in the foundry had to be specially designed to carry the high hanging frame on which the molten metal is moved.



PLANT SPECIALLY DESIGNED FOR CONVENIENCE OF OPERATION

The controlling conditions in the design of the building were convenience of operation, ease of making new additions or extensions to the factory, absence of heavy millwright or machine work in case of change of operations or in the kind of operations carried on, and freedom from delay to operations in case of breakdown of some one part.

Convenience of operation is taken care of by the arrangement of the building. This means not only the separation of the various shops, but their interconnection without interference of one with another.

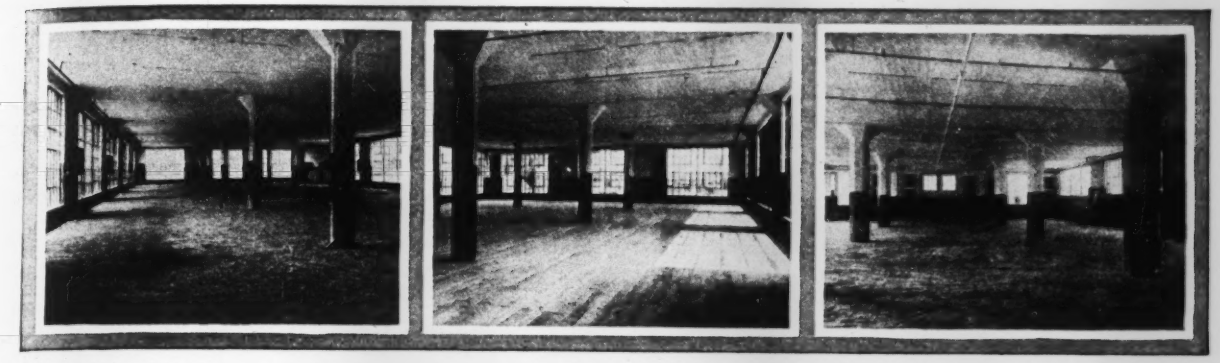
As shown in the accompanying plan layout, the central element of the plant is a craneway, two stories high, 312 ft. long, and 26 ft. wide. Opening out from this craneway are three wings on each side, each housing a separate shop, stockroom or department. All of these buildings are two stories in height except the central wing on the south side, which is occupied by a foundry. In this foundry the two-story height is open from floor to roof, as shown in one of the views. The entrance end of the crane runway is an administration building 50 x 111 ft., three stories high and of a plan varied to meet architectural requirements. At the juncture of the wings with the craneway are additional separate structures, in which are the staircases and toilet rooms. Breakdowns in these rooms will in no way interfere with the shops themselves.

The floor of the craneway and those of the first story shops are on the same level. The openings into the respective shops are of a size sufficient to permit the entry of a motor truck. At the west end the craneway is open to the yard, so that the whole first floor may be controlled by motor trucks. The second floors of the wing shops, besides being reached by the inclosed exterior staircases, are open to bridges spanning the craneway and connecting opposite wings. These bridges, which are shown in the view down the craneway, are also of sufficient width to carry large trucks. Material, then, to reach the second story is dropped by the crane running down the craneway on trucks traveling on the connecting bridges and entering by wide and high doorways into the different shops.

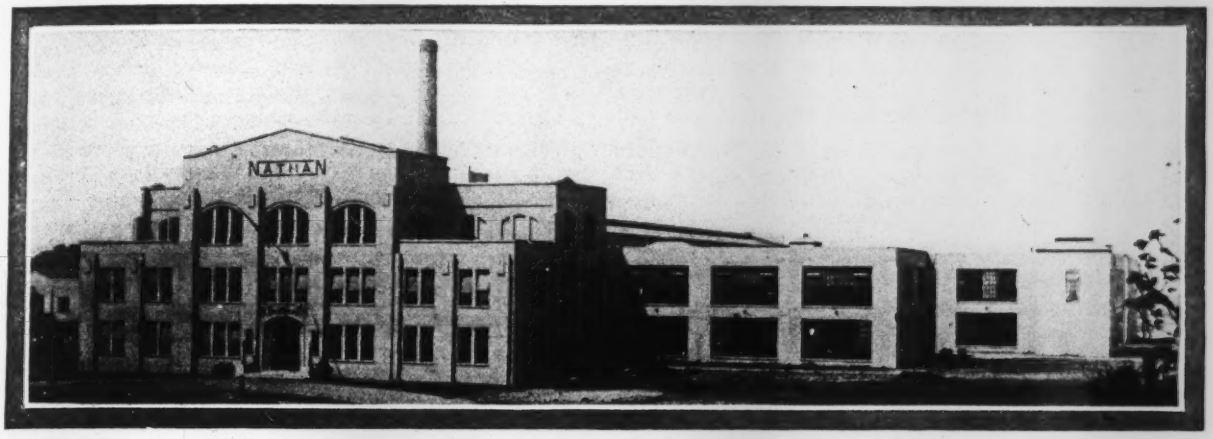
Additions to the plant when needed are also made possible by this layout in wing formation. These wings can be added to or the craneway can be extended and other wings tied to the extension, all without interfering in any way with the present structure.

The design permits very ready and simple change of machinery and equipment in case different kinds of manufacturing operations are required. The flat ceiling, with the drop head omitted, the frequent shaft hanger inserts, and the horizontal and vertical ducts throughout the building make the movement of machinery a matter of unscrewing nuts and bolts and shifting tools, with very little machine work, cutting of metal or of concrete. It will be noted that the shaft hanger inserts are provided with two entrance slots rather than one, thus permitting a certain flexibility in the arrangement or movement of the equipment hung therefrom. It will also be noted that the pipes, except those for sprinklers, are carried at the walls to keep the interferences as low as possible. Two bubble fountains in each shop also require vent pipes.

The general type of floor in the building is wood block,



Typical Wood Block Floor in Shop Wing | Yellow Pine Plank Floor in Shop Wing | Asphalt Block Floor in First Floor Shop



Looking Toward the Administration Building and the First of the Wings of the New Plant

Two-Story Foundry Has Steel Roof Trusses | This Craneway Affords Connection to All Wings

INTERIOR AND EXTERIOR VIEWS OF NATHAN MANUFACTURING COMPANY'S NEW PLANT

but other kinds of floor have been laid in two of the wings and a comparative record is to be kept of the wear of the three different floors, all of which are subjected to about the same conditions. The types, all of which are shown in the accompanying views, are (1) an asphalt block on 1 in. of sand laid on the reinforced-concrete slab; (2) a yellow-pine flooring made of 2 x 6-in. tongue and groove plank laid on sleepers in cinder concrete placed on the slab, and (3) a creosoted wood-block paving laid on ¾-in. of sand over the concrete slab. In the foundry and garage, which are subjected to an entirely different kind of wear, the floors are of 1 in. of concrete laid on a 3-in. cinder bed.

The building is heated throughout by steam radiators which are, as shown in some of the views, hung on the walls, well out of the way of any of the machinery. In the foundry and in the craneway, however, where better ventilation was required, heat is supplied by hot air.

Skylights over the foundry and over the craneway are of asbestos protected metal with wire glass. The inserts, the steel sash and the reinforcement were supplied by the Trussed Concrete Steel Co.

The building is carried entirely on a pile foundation in an extremely quaking soil. In spite of this there has been no observed settlement, although the building is now under its full load.

The entire plant, in addition to the land, will cost about $750,000. This covers not only the main plant described, but also the adjoining buildings, which include a power house, a terminal building on the nearby waterfront and a garage, as well as the development of the ground from a landscape standpoint. The plant was designed by Eugene Schoen, architect, of New York City, and was built by Rheinstein & Haas, Inc., also of New York City.

Building State-Aid Concrete Road Near Grand Rapids

Rich Stiff Concrete Is Used, Floated by Hand and Finished with a Belt—Teams and Motor Trucks Do Hauling

FEATURES in the construction of an 8-mile concrete road near Grand Rapids, Mich., are a stiff concrete mixture, a reinforced stretch over an old corduroy road, steady local labor and a comparison of hauling by horse with motor-truck hauling. This road, which will extend to Byron Center, is being constructed under the Michigan state-reward act, which requires the work to be done by contract. For such roads, built in accordance with the standard plans and specifications of the State Highway Department, this law provides for part payment by the state. The amount paid varies according to the type of construction, and is $2000 per mile for a concrete pavement 16 ft. wide, as in this case.

Because the season was well advanced at the time when the contract was let it was decided to build three miles this year and the remainder in 1918. Construction on this first section was commenced at the end farthest from Grand Rapids, where it meets a cross-road, and was worked back toward the beginning of the road, which is about three miles from the city.

The concrete paving is 16 ft. wide, with a 4-ft. earth shoulder on each side. It is 6 in. thick at the sides and 8 in. at the middle of the road. The concrete is a 1:2:3 mix, made with Newaygo cement and washed sand and gravel, the coarse aggregate being of ¼- to 2-in. size. The mix is thick and heavy, with comparatively little excess water, and is not of the sloppy consistency often employed in road work.

As the concrete is placed it is leveled with a heavy strike made from a steel angle fitted with handles and bent to the required contour of the road. When dry patches begin to show, the surface is floated with wood floats by a man working from a plank bridge or with a long-handled float operated from the side of the road. The surface is then finished with a belt, which is passed over it twice. The aim of the final treatment is to give a wavy granular finish, avoiding a surface skin of cement.

The day after the concrete has been laid, the finished pavement is covered lightly with earth as a protection from sun and wind. This cover is left on for three weeks, or longer in cool weather. It is then removed by a road-grader and team, being thrown off so as to fill the earth shoulders. The road is then ready for traffic, but is not thrown open until the work has reached a cross road.

The inspector is on the work all the time. His daily report to the county superintendent shows the number of hours of work, the number of sacks of cement used, the lineal feet of concrete road laid, and the survey station at which work was stopped.

Expansion joints are filled with ⅜-in. strips of Vulcanite, no steel being used. The material is allowed to project above the concrete, but after the work is completed it is trimmed off with a sharp shovel.

Reinforcing steel is used only at special points. At one place the gravel road is built over an old corduroy road, and in spite of the depth of gravel due to years of renewal and repair the road was so "springy" as to make rough riding for automobiles. Sheets of wire netting are embedded in the bottom of the concrete, but the concrete is of the same thickness as elsewhere and is laid as a single course.

At one point a spring was encountered just under the edge of the concrete paving. Here steel bars were embedded in the concrete, and a pipe drain will carry the water to the side ditch. It has been proposed to put a riser pipe and watering trough for horses at this point.

Concreting Plant and Crew

A Smith traveling mixer with drum of 14-cu.ft. capacity is used. It is of the high type, with the drum set at such a height as to give the chute sufficient slope for the thick mix of concrete. The chute has a maximum reach of 20 ft. from the drum. To allow for the placing of a long stretch of concrete without moving the machine, the chute can be shortened by swinging up the end section. At the upper end of the chute also there is a gate and hopper with vertical drop pipe, ending in a swinging spout, so that the concrete can be deposited close in front of the machine. In this way a length of 18 ft. of road can be concreted before moving the machine.

The state specifications call for striking or leveling each wheelbarrow load, but in practice the sand and gravel are heaped in the usual way to insure a full load. The water is pumped about two miles to the mixer, through a line of 2-in. to 1¼-in. pipe. The water supply for each batch is measured automatically, but there may be some excess, should dirty water interfere with the proper closing of the valve. The concrete is retained in the mixer drum for at least 16 revolutions, or a period of 45 seconds.

The crew consists of 16 to 18 men, mostly Hollanders from the locality. They are good workmen and stay on the job, so that the contractor is free from the present usual trouble of continual changes in the crew. When the concreting is in progress there are eight men shoveling and wheeling sand and gravel, one operating the mixer, one emptying the cement sacks into the charging hopper, and three shifting the delivery chute and spading the material into place. Two of these men also operate the strike. Other men attend to the steel forms.

The working time is 9 hours, exclusive of the hour for lunch. The highest record is 300 ft. of 16-ft. roadway laid in one day. On the present 3-mile stretch the men are carried to and from work on a motor truck.

The sand and gravel are obtained from a large pit and washing plant near the city end of the new work. At this pit a steam-shovel, working along the breast, dumps the material through a portable hopper upon a belt conveyor extending along the full length of the breast. This delivers the material to a second conveyor, at right angles to the first, which in turn delivers it to an inclined belt conveyor discharging at the top of the screening and washing plant.

The maximum haul is about two miles. This is considered about the economic limit for teams, and ordinarily the contractor would have used his fleet of motor trucks here. The haul, however, is over a temporary road in loose sand, in which the large trucks get stalled. For this reason most of the hauling this season is done with 1½-yd. dump wagons and teams. For the longer haul on next season's work the motor trucks will be used. These include United, Kissel and G. M. C. trucks, all of the end-dump type.

The materials are dumped on the rolled subgrade, the gravel on one side in a continuous pile, and the sand on the other side, with loads about 5 ft. apart. A snatch team helps to haul the loaded wagon into position and to pull it clear of the heap when dumped. Cement in sacks was at first stored in a tent halfway along the work, and thence was distributed by a team, but after the work reached this point the cement was delivered from the city by motor trucks.

The surface of the old road is leveled and surfaced with a grader and team, and then compacted with a 13-ton Kelly-Springfield steam roller. The specifications require a roller of not less than 10 tons. This subgrade, however, is cut up by the wagons delivering material, and has to be filled and leveled to grade by hand in advance of the concreting outfit. After the curing of the concrete pavement, the shoulders are filled and dressed by means of a grader and buck or fresno scrapers.

The culverts are mainly of 12-in. and 18-in. corrugated ingot-iron pipe with concrete end walls. There are also some 36-in. concrete arch culverts. The only large structure will be a concrete bridge, having an arch span of 55 ft. At one point on next year's work there will be a piece of grade reduction, involving 4000 cu.yd. of excavation in a cut 700 ft. long and about 6 ft. deep. This will be handled with a revolving steam shovel having a ⅝-yd. bucket.

The Golden & Boter Transfer Co., of Grand Rapids, has the contract. C. K. Whiting is engineer for the Kent County Commissioners. John Paas is county superintendent of roads and C. A. Payne inspector having direct supervision of the work.

Electric or Oil Engine for Railway

Electrification or equipment with internal-combustion locomotives, for securing better financial conditions, is proposed for the 120-mile New Mexico Central Ry. by the Federal Export Corporation of New York, which has recently purchased the property. The road extends from Santa Fe to Torrance, N. M.

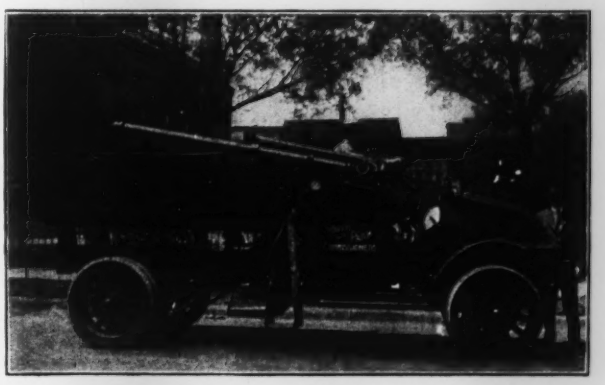
Auto-Eductor Is Used To Clean Chicago Catchbasins

Found To Be Much Quicker and Cheaper Than Hand Labor—Machines Can Be Converted Into Ordinary Trucks

PERFORMANCE and cost data of the cleaning of sewer catchbasins by an auto-eductor (pump and suction device) attached to a motor truck are given in a report by George E. McGrath, superintendent of the bureau of sewers, Chicago.

In August, 1917, the operating cost was $351. The machine traveled 521 miles; cleaned 387 catchbasins at a cost of 91c. each and removed 623 cu.yd. of dirt at a cost of 58c. per yd. This work was in the business district, where all sewer cleaning must be done at night. Cleaning catchbasins by hand in this district costs on an average $3.35 per basin. If the same amount of work could have been done by hand, it would have cost $1296. The cost of operation of the machine was distributed as follows: Driver, $115 per month; two laborers at $3.60 and $3.30 per day; total cost for labor, $283. Repairs, fuel and depreciation, $67. Total cost for the month, $350.

The eductor was invented by G. W. Otterson, and the truck with eductor and all attachments is built by the Kelly-Springfield Motor Truck Co., of Springfield, Ohio. The machine used by the Chicago Bureau of Sewers has



AUTO-EDUCTOR FOR CLEANING SEWER CATCHBASINS IS USED BY THE SOUTH PARK COMMISSION, CHICAGO

a 5-yd. body on a 5-ton truck frame and weighs 7 tons empty. A somewhat smaller truck with this equipment, used by the South Park Commission, Chicago, is shown in the accompanying view.

The eductor consists of a 4-in. telescopic pipe, with a horizontal discharge branch at the top. At its lower end is an elbow connected to a 3-in. pipe, from which a hose is led to the discharge of a centrifugal pump. A 1-in. nozzle from the 3-in. pipe is led into the 4-in. pipe, where it is turned upward.

The 14-in. centrifugal pump is mounted on the right side of the truck frame and its suction is connected to the body of the truck. It is driven by a silent link-belt chain from a power take-off attached to the driving shaft of the truck. The sprocket on this shaft runs idle normally, and is engaged by means of a lever near the driver's seat. A pressure gage enables the driver

to regulate the motor to give the proper speed and pressure at the pump. The ratio of the sprockets is such that the required pressure of 40 to 50 lb. is obtained at a low motor speed.

The body of the truck is a watertight steel box. Its tail gate is hinged at the top and is made watertight by means of clamp bolts which press a rubber gasket against the end frame. The door latches are released from the front end, so that the operator is clear of the water that escapes when the tail gate is opened. An opening in the bottom provides for the attachment of the inlet valve on the pump suction, and an opening in the side provides for the overflow valve. A top plate at the forward end protects the driver from the splash of the discharge.

Within the body is a frame carrying transverse hinged baffle plates, and having a longitudinal partition plate extending the full length of the body. The 8½-in. space between this partition and the side of the truck is termed the clear-water compartment. The first three baffles extend only to the partition and have openings in the upper portion so spaced as to cause the flow of water and refuse to follow a long path. By this means most of the solid matter settles before the flow reaches the end baffle.

This last baffle plate extends the full width of the body and is pierced with ¾-in. holes. Thus the flow is screened as it passes out of the main part of the body and again as it enters the clear-water compartment, with which the pump is connected. Spacers hold the baffles in position when the tail gate is closed. The opening of this gate releases the spacers so that the baffles can swing back and give free discharge to the contents as the body is dumped.

The machine can be converted into an ordinary truck for handling stone, gravel and other material. For this purpose the bottom is made of heavy plate, the baffle frame is removable and the two valve openings can be closed by bolted covers.

In starting its work the truck, with body partly filled with water, is run close to the catchbasin. The eductor arm is loosened and run out to position over the manhole, and then the telescopic pipe is lowered until it rests on the refuse in the catchbasin. The pump is then started, drawing water from the truck body and discharging it into the 4-in. pipe through the 1-in. nozzle at 40- to 50-lb. pressure. This upward jet causes the refuse to flow into the pipe, where it is carried up and discharged into the truck. There the solid matter settles and the water comes back through the clear-water compartment to the pump.

Excess water escapes through an overflow valve and runs back to the sewer. The flap valves of the pump inlet and the overflow are operated by a cable from the driver's cab. Stones up to 2½ in. in largest dimension are passed through the eductor. The truck goes from one catchbasin to another until it is filled, and then to the dump.

Columbus Makes Money from Garbage-Reduction Works

A NET PROFIT of $18,868 was made by the garbage-reduction works of Columbus, Ohio, in 1916, according to the latest annual report of T. D. Banks, superintendent. The amount of garbage treated was 21,862 tons, and the net revenue per ton nearly $0.91.

The total receipts of the plant were $88,564, or $4.051 per ton of garbage treated. The garbage yielded 3.076% of grease, or 1,344,789 lb., and brought a revenue of $69,452, which was over 5c. a lb. of grease and $3.177 per ton of garbage. The tankage yield was 10.307%, or 2253 tons, which brought nearly $8 per ton of tankage or $0.808 per ton of garbage. The remaining $1440 of revenue was for 156 hides, which added $0.066 to the revenue per ton of garbage treated.

The cost of operation and maintenance was $48,424, or $2.215 per ton of garbage. Interest and depreciation amounted to $21,272, or $0.972 per ton, making the total cost of disposal $3.187 per ton. The detailed cost of operation and maintenance is shown by the accompanying table.

COST OF OPERATION AND MAINTENANCE OF GARBAGE-REDUCTION WORKS, COLUMBUS, OHIO, IN 1916*

	Amount	Per Ton
Supervision	$3,000 00	$1 37
Clerk hire	656 70	3 0
Labor:		
Firemen	2,970 28	13 6
Ordinary	13,123 39	60 0
Operators	4,248 17	19 4
Foremen	2,349 23	10 7
Office supplies	122 26	0 7
Fuel	9,145 29	41 8
Clothing	60 25	0 3
Mechanical supplies	795 96	3 6
Motor vehicle supplies	256 73	1 2
Chemical supplies	3,063 89	14 0
Other supplies	493 14	2 3
Traveling expense	3 30	0 0
Telephone and telegraph	71 60	0 3
Advertising	16 90	0 1
Insurance	197 00	0 9
Taxes and rent	55 30	0 3
Light and power	1,686 60	7 7
Other service	312 88	1 4
Maintenance buildings	3 95	0 0
Maintenance railway tracks	10 42	0 1
Maintenance equipment, labor	2,059 48	9 4
Maintenance equipment, material	3,555 40	16 3
Maintenance motor vehicle	161 12	0 7
Other maintenance	4 41	0 0
Total	$48,423 74*	$2 215*

* Elsewhere in the report from which this table is taken mention is made of a criticism regarding the omission of water from the operating cost. Mr. Banks considers an allowance of 15½c. per 1,000 cu.ft., or $3,100 a year, ample. This would add about 14c. per ton to the cost of operation and diminish by that amount the net revenue given in the text.

The coal consumption totaled 5950 tons, or 0.2726 tons per ton of garbage; electric power, 112.44 kw-hr., or 5.144 kw.-hr. per ton of garbage; gasoline, 18,923 gal., or 0.8656 gal. per ton of garbage.

The estimated population of Columbus for 1916 was 215,000, giving 203.33 lb. of garbage per capita.

Detailed operating figures for the 1913 and 1914 operations of the Columbus garbage reduction work were published in *Engineering News* of May 27, 1915, page 1030.

Garbage Works in Center of City

Keeping the garbage-reduction works of Rochester, N. Y., at their present central location, instead of removing the plant eight miles to the site of the sewage works, was approved recently when the reduction works were bought by the city. The plant, unlike most garbage-reduction works, is near the geographical center of the city, thus effecting a considerable saving in the cost of garbage transportation. The decision was made on the recommendation of E. A. Fisher, consulting city engineer, after he had visited other reduction works.

Ultra-Violet Rays Finish Treatment of Henderson Water-Supply

Sedimentation, Mechanical Filter and Ultra-Violet Purification Plant Has Been in Service Several Months—New Form of Sterilizer Used—Typical Bacterial Results

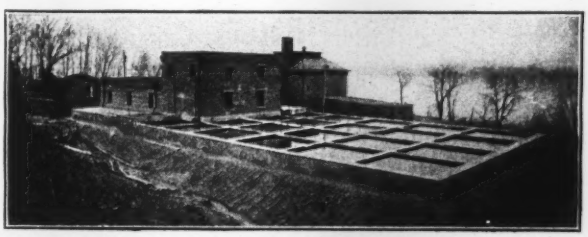
By A. T. Smith
R. U. V. Co., Inc., New York City

THE large pressure-type ultra-violet-ray sterilizers now in operation at Henderson, Ky., are the first of this type in the world designed for use in connection with municipal water-works. The water delivered to the sterilizer is first passed through sedimentation and coagulating basins and mechanical filters, and after this treatment it is at all times virtually clear. The sterilizer units are automatic in operation.

The City of Henderson, Ky., located on the Ohio River, about twelve miles below Evansville, Ind., secures its water-supply from the Ohio River. It has a population of about 17,000. Up to 1916, untreated water was pumped to a 4,000,000-gal. reservoir. The storage was equivalent to less than two days' supply, the average daily consumption being about 2,500,000 gallons.

The city, after considering various schemes, finally accepted the joint proposition of the R. U. V. Co., of New York City, and the Pittsburgh Filter Manufacturing Co., of Pittsburgh, for a complete sedimentation, filtration and sterilization plant at the pumping-station site, to have a nominal capacity of 3,000,000 gal. per day and designed to be increased to double that capacity without affecting the present structures.

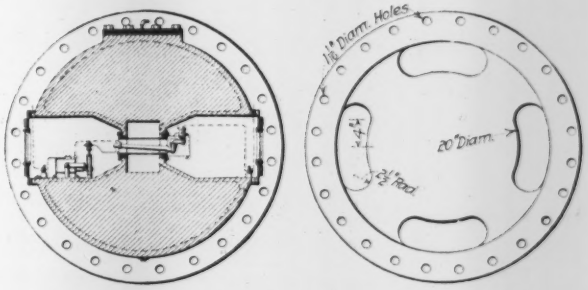
The design was passed upon by J. W. Ellms, consulting engineer, Cincinnati, Ohio. There are two coagulating basins, each 95 ft. long, 30 ft. wide and 16 ft. in depth; and two baffled mixing chambers, 7½ ft. wide, 25 ft. long, and 17½ ft. in depth. The detention period in the coagulating basins is four hours on a capacity of 3,750,000 gal. per day, and the capacity of the two settling basins is 620,000 gal. Six reinforced-concrete filter units were installed, each 17 ft. long by 13 ft. 4 in. wide, with a normal capacity of 625,000 gal. each, totaling 3,750,000 gal. per day.



HENDERSON MUNICIPAL WATER-WORKS HAS COMBINATION MECHANICAL FILTER AND ULTRA-VIOLET PURIFICATION PLANT

The filters are of reinforced-concrete throughout, with a brick building covering the filters and the head house. A clear-well covers the entire area below the filter units and pipe gallery. Adjacent to this, on the outside, is a low reinforced-concrete building, 17 ft. wide by 28 ft. long, in which is placed the ultra-violet-ray sterilization apparatus.

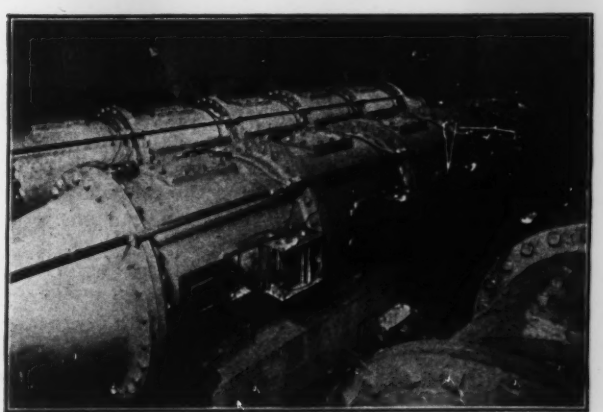
The ultra-violet-ray sterilizers consist of three legs, each comprising five units. The legs are connected in parallel, while the entire equipment is connected in series with the pipe line leading from the clear-water basin to the sump from which the pumps draw their supply. Valved increasers and reducers are provided to connect the sterilizer with the service pipe line, as the sterilizer units are made 30 in. in diameter to secure low velocity.



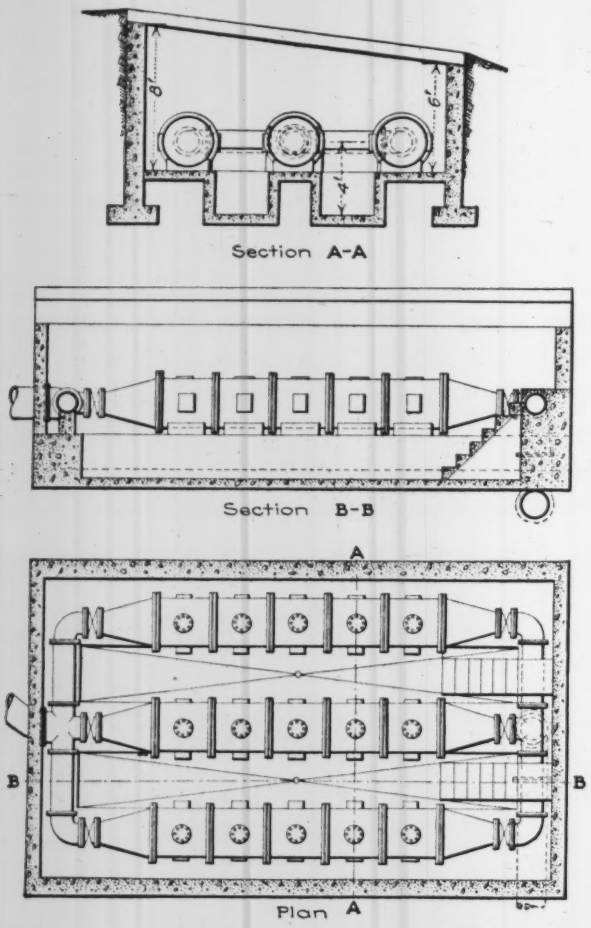
SECTION THROUGH ULTRA-VIOLET UNIT, AND ELEVATION OF BAFFLE

Each unit has a lamp box inserted in its side, equipped with a clear quartz closed-end tube, which projects into the body of the unit and around which the water is forced to flow in a thin film, by means of a baffle placed at 90° to the long axis of the sterilizer. The baffle has a slotted opening to receive the quartz tube and to provide for passage of the water.

Inside the quartz tube is placed a 220-volt direct-



NEW LARGE TYPE OF ULTRA-VIOLET UNIT HAS BEEN DEVELOPED FOR MUNICIPAL PLANTS



ULTRA-VIOLET STERILIZER WAS BUILT WITH THREE PARALLEL FIVE-UNIT LEGS

current mercury-vapor arc lamp. It is properly held in place and automatically tilted by a special support which is located in the lamp box.

An iron baffle plate with four large holes is inserted in each unit to insure bringing each particle of water into the field of the ultra-violet rays during its passage through the apparatus.

Each lamp is provided with a small individual switch cabinet to provide proper electrical starting characteristics. A main switchboard is also provided and placed adjacent to the filter-operating room. This board has mounted on it a tell-tale incandescent lamp for each ultra-violet lamp in the sterilizer, main-line switches and indicating instruments. There is also a warning bell which rings when a tell-tale lamp is lighted.

If any ultra-violet lamp fails or diminishes in power from any cause, the bell rings and the tell-tale lamp on the main switchboard shows which lamp or lamps in the sterilizer are in trouble.

A motor generator set is provided to transform the available alternating current into 220-volt direct-current.

The accompanying tabulated results have been taken from daily tests run continuously for over two months and are offered to indicate the effectiveness of the ster ilizer.

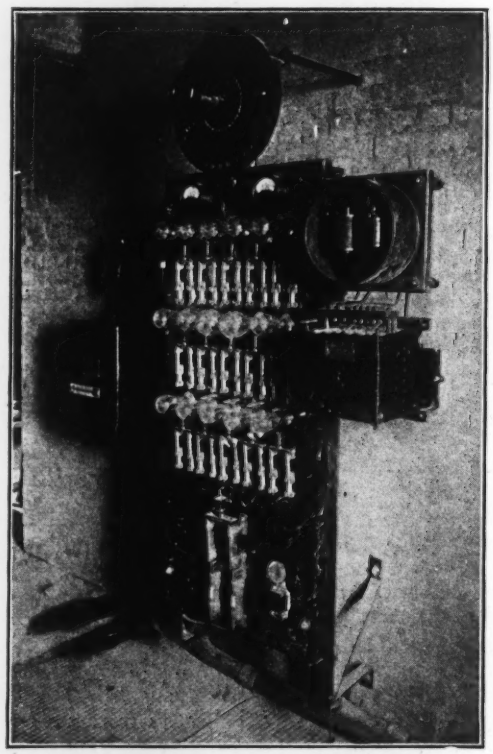
The bacteriological work was done in accordance with standard methods of the Laboratory Section of the American Public Health Asociation, and the average results were closely checked by the maximum and minimum obtained, which vary little from average results.

TYPICAL RESULTS, BACTERIAL TESTS AT HENDERSON WATER-PURIFICATION PLANT

		Bacteria per c.c., 24-hr. Incubation			
	Total No. of	Total Bacteria		B. Coli	
Sample	Samples	Maximum	Average	Maximum	Average
Raw	25	190,000	85,000	1000 0	276 0
Coagulated	25	1,200	720	100 0	43 0
Filter	70	320	80	1 0	0 065
Leg 1:					
Influent	52	95	32	1 0	0 360
Burner 1	48	30	16	0 8	0 215
Burner 2	48	20	8	0 8	0 200
Burner 3	48	16	6	0 2	0 136
Burner 4	48	6	2 10	0 1	0 030
Burner 5	54	3	0 31	0 0	0 040
Leg 2:					
Influent	53	75	36	1 0	0 310
Burner 1	47	50	12	0 6	0 273
Burner 2	47	20	6	0 8	0 18
Burner 3	47	7	5 20	0 4	0 117
Burner 4	47	6	1 80	0 1	0 07
Burner 5	54	3	0 38	0 0	0 0
Leg 3:					
Influent	54	95	25	1 0	0 326
Burner 1	47	55	14	0 8	0 240
Burner 2	47	19	9	0 8	0 21
Burner 3	47	12	4	0 4	0 110
Burner 4	47	6	1 60	0 1	0 05
Burner 5	54	3	0 42	0 0	0 0
Tap at pumps	34	11	0 39	0 0	0 0

Rate of pumping 2,200,000 gal. per day to 3,200,000 gal. per day, with little or no variation in results.
Turbidity of raw water varied from 130 to 880 r.p.m.
Filtered water usually clear with maximum turbidity of 5 r.p.m.

The plant was put in operation toward the end of 1916 and has since run under a varying capacity from 2,200,000 to about 3,500,000 gal. per day. The current



SINGLE SWITCHBOARD PANEL CONTROLS THE ULTRA-VIOLET PLANT

consumption guarantee of 0.77 per lamp was met in operation. The cost of final sterilization by this method can be estimated from the current consumption, which is 92.5 kw.-hr. per 1,000,000 gallons.

Waterwheel Reversed To Absorb Energy During Test

Method of Rating Efficiency of Hydraulic Units Without Water Rheostat Effectively Used at Crosscut Plant

THE contract for the hydraulic equipment in the crosscut hydro-electric plant built for the U. S. Reclamation Service on the Salt River Reclamation Project in Arizona was let with bonus or penalty dependent upon the efficiency obtained. A careful test was therefore decided upon and the methods by which it could be made were studied and compared. The general features and layout of the plant were described in *Engineering Record* of Jan. 1, 1916, p. 19, and in *Engineering News* of Apr. 20, 1916, p. 740.

It was agreed that the high voltage and low amperage made it inadvisable to use the usual water rheostat method for absorbing load. With the consent of the waterwheel manufacturer it was therefore decided to connect the generator of the wheel under test with a generator of another unit in such way that the latter would be run as a motor. Thus the load could be taken up by the jets from the nozzles retarding the reverse rotation of the buckets.

The specifications provided that any one of the six units might be selected for test, and number one was chosen. The plant is provided with a busbar system of the common double bar or loop type, with disconnecting switches at either end of the loop. For the duration of the test these switches were opened, and all of the plant and interchange load was transferred to one bus. The other bus was used for connecting the unit under test to the unit supplying the load.

Taking excitation from a separate exciter, these two machines were thrown on the isolated bus. On bringing the machine selected for test to speed, the machine selected for load also came up to speed as a synchronous motor. The connections on the unit intended to supply the load were reversed, of course, so that when supplied by power from an external source its direction of rotation was opposite to normal.

Hand Regulation Only

After some experiment it was decided to disconnect the governors and rely entirely on hand regulation. One penstock was used for supplying water to the unit under test and another for supplying water to the exciters and providing the load in the braking unit. With water admitted through the nozzles of the unit operated as a synchronous motor, electric energy was absorbed in direct relation to the hydraulic energy developed by water passing through its nozzles. Therefore, as the nozzles were gradually opened on the unit under test a relative additional quantity of water was admitted to the motoring unit. It was necessary to observe care in manipulation of the field rheostat to avoid the breaking of step on the part of the motor unit, but after some experimenting little difficulty was found in gradually controlling the load and speed of the generating unit.

The stresses imposed on the buckets were the direct opposite of the stresses for which the unit was designed. Notwithstanding this fact, the motor unit was operated in this condition almost continuously for two days. It is notable that the Kingsbury bearing on the motor unit, although designed for rotation in one direction only, showed no undue distress throughout the entire run. The gross efficiency of the impulse wheel obtained was 79.26%, or, correcting for loss of head, due to the requirements of settin the waterwheel runner above level of water in the tailrace, a net efficiency of 83.5% was obtained.

How Tar Mat Is Applied to Concrete Road Base in Maine

TO INSURE a good bond between concrete base and tar mat surfacing, a type of construction which, in the case of the road near North Kennebunkport, Maine, presents a smooth, wearing surface after four years of service, the State Highway Department has adopted the following practice:

1. The concrete base is swept carefully. This is important as a slight film of dust will prevent the tar from sticking to the concrete.

2. One-fourth of a gallon of hot tar (in this case Tarvia A) is applied under pressure by a mechanical distributer.

3. Wherever there is the slightest doubt as to the adhesion of the tar to the concrete, the tar is broomed to insure that the dust, which is always to be found on the surface of a concrete road, does not prevent proper adhesion.

4. Pea stone, as much as 1 cu.yd. per 200 sq.yd. of pavement, is then applied.

5. The mat is then rolled with an 8-ton roller.

6. The surplus screenings are swept away. This is necessary if the second application of tar is to obtain a proper bond.

7. After sweeping, a second coating of tar, about ¼ gal. per sq.yd. is applied.

8. The second coat of tar is covered liberally with pea stone.

9. The pavement is then rolled again with a roller weighing about 8 tons.

10. The surface is blotted with sand.

The following is the record of wear: First year, no repairs; second year, slight patching; third year, slight patching; fourth year, a fair amount of patching; fifth year, liberal patching (estimated); sixth year, re-treatment.

Just what it has cost to keep this mat patched and in perfect condition it is hard to say with exactness, for it is very hard to separate the time spent on patching from the time which the patrolmen or other road laborers spend on other features of road maintenance. It is thought to be conservative, however, to state that keeping this mat in place has cost less than $50 per mile per year. In view of the heavy traffic over this road, which is a section of the Portsmouth-to-Portland road and carries unusually heavy motor traffic, it is thought that the success of this mat is worthy of note. The aim of the Maine Highway Department, of which Paul D. Sargent is chief engineer, has been to get a perfect bond between a good mat and a good piece of concrete.

Concrete Building Has Long-Span Girders and Floor

At Emory University Part of Library Floor Is a Square Slab 37½ Feet on a Side, and in Roof Is a 52-Foot Girder

A SQUARE reinforced-concrete floor slab with a clear span of 37 ft. 6 in. is a special feature of the design of the frame for twin buildings of the new group of structures for Emory University at Atlanta, Ga. Further novelties of the concrete design are a spiral stairway in one of the buildings and a roof girder of 52 ft. 2 in. span which not only carries the roof load but a depending 8 in. concrete partition which was thought too heavy for the long span floor noted in the previous sentence.

The twin buildings of the recently constructed group of structures are placed about 200 ft. apart and are designated as the School of Law building and the School of Theology building, with an open court between. The plan for each is about 53 x 154 ft., with a rear wing in the theology building and a spiral stairway in the law building. Concrete foundations of unreinforced spread footings 2 ft. wide for the walls are carried down to stiff clay, and interior columns are supported by concrete piers without steel, the loads for these two-story structures being relatively light.

The basement in the law building is excavated on the south side only, and has a 6 in. concrete floor. The main entrance is on the longer or court side, at about the center of the building, and leads through an arched passage directly to the spiral stairway in the rear. On the first floor at the west end is the large library, about 52 ft. square, with twelve diagonal columns which support the second floor and are spaced about 7 ft. inside of the walls. Offices and a large lecture room with stepped sloping floor occupy the balance of the first floor. The second floor consists of lecture rooms and offices.

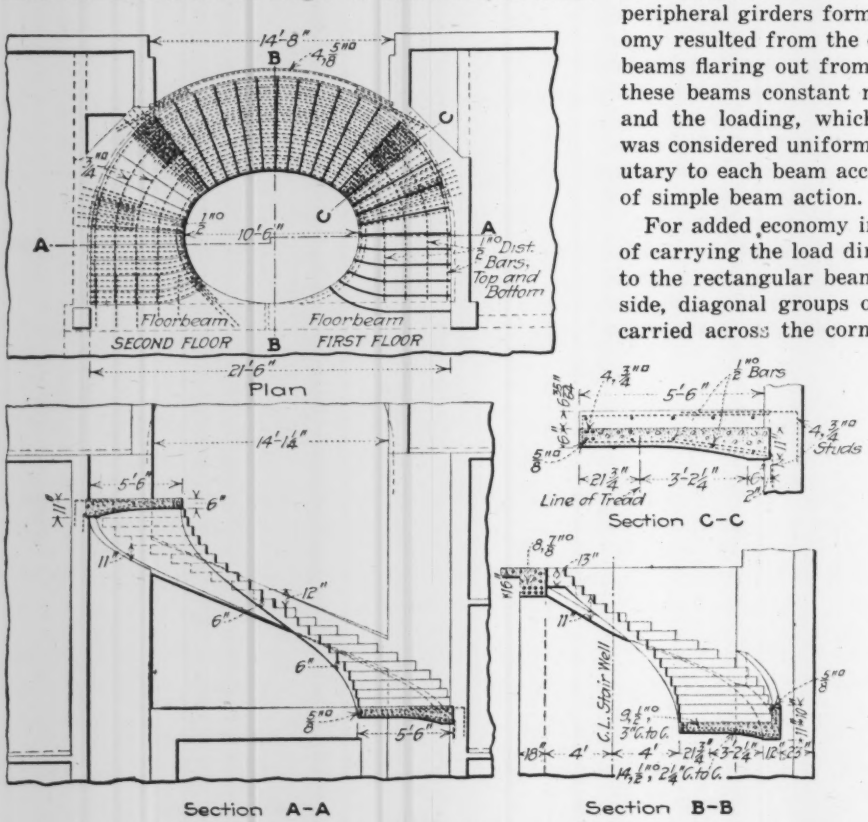
Springing from a beam of the first-floor framing in the law building, a spiral stairway of reinforced-concrete 6 ft. wide winds through an angle of 180° to a parallel beam of the second-floor framing about 18 ft. above. The rise of each step is slightly over 6½ in. and tread 11 in., and the concrete is faced by marble slab treads 3 in. thick and risers 2½ in. thick. The concrete steps are reinforced, as noted in one of the drawings, by both radial and spiral steel.

To support the curved steps at intermediate points, reinforced-concrete cantilever beams are used at the walls, and the spiral steel is designed to transfer loading to these beams. The walls and columns are located in plan as near the spiral stair as practicable in order to decrease the bending effects of the cantilevers.

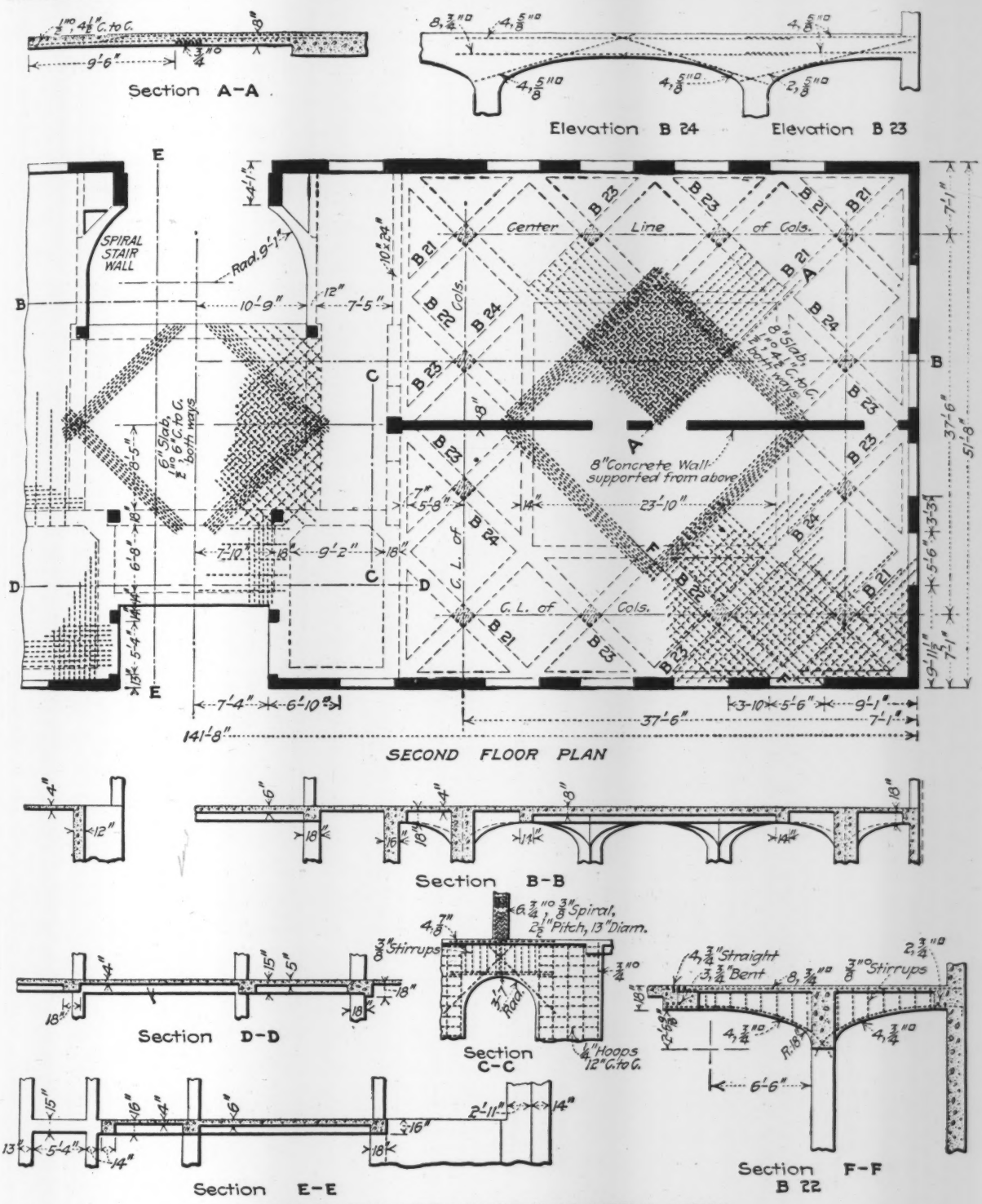
The large unsupported floor slab is located over the library. Here the architectural treatment of the ceiling to give a ribbed dome effect and the structural necessity for economical design of such a large square slab led to the use of diagonal beams curved on the bottom and acting as cantilevers over the columns. These support an 8-in. slab with two-way reinforcement combined with diagonal steel for beam action to carry loads to peripheral girders forming a deep central panel. Economy resulted from the cantilever action of the diagonal beams flaring out from the columns. In the design of these beams constant moment of inertia was assumed and the loading, which is taken as 75 lb. per sq.ft., was considered uniformly distributed over all area tributary to each beam according to the usual assumptions of simple beam action.

For added economy in the design of the slab, instead of carrying the load directly by two-way reinforcement to the rectangular beams forming a square 19 ft. on a side, diagonal groups of rods, as shown in plan, were carried across the corners of the square, making possible an 8-in. slab by using two-way diagonal rods tributary to these strongly reinforced sections acting as beams.

A similar slab in the second floor above the entrance corridor is seen in the plan, about 17 ft. square and only 6 in. thick, where the same principle of load distribution by slab-and-beam action was applied. In the case of the large slab over the library, the dead load was decreased by supporting the 8-in. concrete partition wall, as shown, from a reinforced-concrete girder in the roof above.

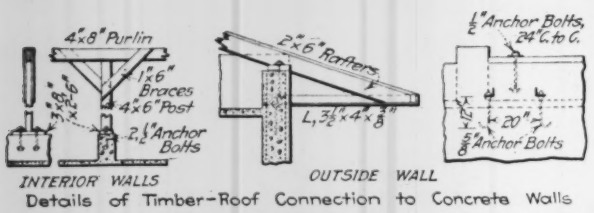


PLAN AND SECTIONS SHOW REINFORCEMENT IN SPIRAL CONCRETE STAIRWAY

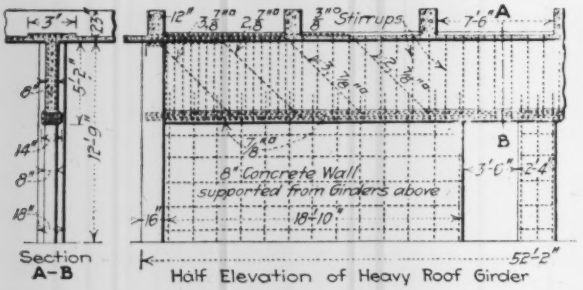


The reinforced-concrete roof girder of 52 ft. 2 in. span, details of which are shown, was adopted to carry the roof loading and weight of partitions to the outside wall and interior column. The latter column is 16 x 18 in. and delivers the load to a wall beam carried by interior walls or columns, as seen in the plan. In designing this large girder, 5 ft. 7 in. total depth, economy was attained by using an 8-in. web thickness with a lower flange widened to 14 in. to accommodate the 22 reinforcing rods required, and using the roof slab as upper flange area.

The 3-in. concrete ceiling is framed into concrete beams which extend upward in order to give a flat ceiling. Above the concrete framework, largely for the



Details of Timber-Roof Connection to Concrete Walls



ROOF GIRDER 52 FEET LONG SUPPORTS PARTITION WALL BELOW ROOF

purpose of architectural finish, a red tile sloping roof is supported on timber framing, some of the details of which are indicated in the same drawing as the large roof girder.

The main walls are, in general, 8 in. thick, reinforced in both directions by ⅝-in. square rods spaced on 18-in. centers, with arched opening for doors and windows. The outside walls are finished by large-size colored Georgia marble mosaic formed of 1¼- to 2-in. slabs in varying sizes, set in portland cement. This marble is pink, gray, white or dark green in color and gives a warm-toned appearance to the buildings.

The architects for these buildings are Palmer, Hornbostel & Jones, New York City, and the design and construction were made and supervised under the direction of the contractor, Arthur Tufts, Atlanta, Ga.

Concrete Road Maintenance Details on Toronto-Hamilton Highway

By H. S. Van Scoyoc
Chief Engineer, Toronto and Hamilton Highway Commission

THE maintenance gang on the Toronto and Hamilton cement concrete highway discontinued the use of a horse and wagon and a 3-bbl. tar kettle in filling the cracks and joints this season. A tar kettle having a capacity of only one barrel was substituted and was moved along the highway by the men. A ½-ton motor truck conveyed the men to and from work, transported the tar and blanketing material and hauled the tar kettle when long moves were made. During much of the time the truck and driver were employed by the construction department for a part of the day.

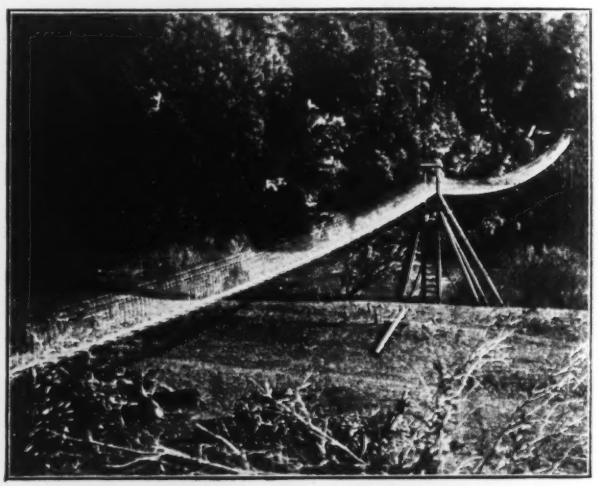
In some of the wider openings the objectionable settling away of the tar was avoided by calking the bottom of the cracks with oakum. This treatment also effected a saving in the quantity of tar required, as none of it flowed away underneath the slab.

In an endeavor to clean out the openings quickly a bellows was tried out, but the results were not satisfactory. All of the cracks were carefully cleaned and the narrow ones were chiseled down to a depth of about ½ in. An attempt was made to have the opening wider at the bottom than the top so that the tar would tend to remain in place. Up to the present, substantially all of the tar poured this season is still adhering.

Wire Mesh Instead of Cable in a Western Suspension Bridge

A SUSPENSION foot-bridge was recently built across the Rogue River at Agness in Curry County, Washington, with wire fencing instead of cable as the suspension member. It was necessary to build a high-level bridge, and the cost, weight and difficulty in securing steel cables led to the decision to try the fencing.

The bridge is 659 ft. from anchorage to anchorage; the span over the water is 380 ft. About 2000 ft. of fencing was used in the two sides and the bottom strip. No joints were made on the bridge. The fencing used on the sides has a No. 7 top wire, the second wire and the bottom wire are size No. 9, and the 17 intermediates are No. 11. The crossbars are spaced 1 ft. apart. The flooring of the bridge consists of a field fencing with No. 9 wires at either edge and eight No. 11 intermediate wires. The crossbars in the flooring are No. 11 wire, spaced 1 ft. apart as on the sides.



WIRE-MESH SUSPENSION BRIDGE OVER ROGUE RIVER, AGNESS, WASH.

Piers and anchors for the bridge were constructed of cedar logs hewn out with the ax. The main timbers are 12 x 12 in. at the bottom and 10 x 10 in. at the top. The top of the highest pier is 40 ft. above the ground.

Drainage Outlook Points to Betterments Only

Improvements of existing drainage districts, to overcome the difficulties and inadequate facilities shown up so clearly in the 1915 floods, will make up the bulk of drainage work next season, according to a Middle West consulting engineer who has plans for an expenditure of $2,000,000 for revamping projects. Nothing that cannot bring results within a year's time is going ahead, but there is great activity looking toward putting these projects in good workable shape.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Should Engineering Students Be Drafted?

Sir—If the authorities persist in drafting students of the junior and senior classes in the engineering schools, I believe that a serious condition of affairs will result during the next two to six years in this country. I have daily applications for young engineers and have none to recommend. Anyone can understand what the condition will be if the thousands of students who would be engineers next June and the June after are sent to France as soldiers in the ranks or are driven out of school into shipbuilding and allied industries in which they will be exempt from service.

I write this letter to ask you to use the influence of your journal in attempting to correct this situation. In this war and in this country young engineers are certainly as valuable as young medical students.

PALMER C. RICKETTS,
President, Rensselaer Polytechnic Institute.
Troy, N. Y.

The War's Effect on Enrollment in Engineering Schools

Sir—In further reply to your comments on the movement to enlarge the attendance at the technical schools of this country, I beg to call your attention and that of your readers to editorials on pp. 344 and 346 of the October 31st issue of *Engineering and Contracting*, entitled "The Effect of the War on Enrollment in Civil Engineering Departments of American Colleges." From those editorials it will be seen that there is a marked decrease in the number of students in the civil engineering courses of this country. The number of the schools recorded as answering the editor's questionnaire is sixty—certainly enough to give a fair average.

For five years past the number of engineering students in attendance at the schools has been decreasing; and in the present scholastic year, as compared with the preceding one, the drop thus far has been twenty-four per cent. It is true that the freshman classes show a trifling gain of two per cent. This is undoubtedly due to the various appeals made to the public, urging increased attendance, but the percentage of increase should have been much greater in order simply to maintain equilibrium; and, in my opinion, it should have been at least one hundred in order to meet the probable demand for young engineers after the close of the war.

The editorial referred to states that "Since the opening of the college year the advertising of engineering colleges has again become conspicuous by its meagerness." This is wrong; because the freshman classes should be increased in every practicable way. Probably the school authorities deem that it is now too late to add materially to the size of the freshman classes. Under ordinary conditions, that is quite true; but it would not be difficult to have two freshman classes, and let the second one work steadily through all the vacations until next autumn and thus catch up with the first class. In truth, during the war period, and for some time thereafter, all engineering courses should be, as nearly as practicable, continuous, in order that the upper classes may finish ahead of time and get into practical work, where engineering services now are and will continue for some time to be in great demand.

Some instructors may object to the hardship of doing the extra work; but if they feel inclined to complain, they should remember that to work overtime on teaching is far less onerous than serving in the trenches. Again, it is possible to work the students twelve months per annum and to work the individual instructors a much shorter time.

Decidedly, some radical steps should be immediately taken to augment materially the number of men in the freshman technical classes of this country.

J. A. L. WADDELL,
Kansas City, Mo. Consulting Engineer.

[The *Engineering News-Record* has been fully alive to the necessities of the situation mentioned by Dr. Waddell. The results of its efforts to learn the extent of the damage already done can be found elsewhere in this issue. Attention is also directed to the editorial attitude outlined on p. 996.—Editor.]

Engineers and Civil Service Examinations

Sir—The attention of the U. S. Civil Service Commission has been directed to the letter appearing on page 802 of *Engineering News-Record* of Oct. 25, under the heading: "How One Engineer Feels About the Civil Service Examinations." The statement is made in the article that in attempts to evade the civil service rules there is at one end of the scale "the engineer of ability who resents any attempt at dictation as to the men he shall employ" and there is at the other end of the scale "the politician who wishes to appoint friends incapable of passing the examinations."

The first part of this proposition has not been the experience of the Federal Civil Service Commission; on the contrary engineers of ability in the government service who may at first have opposed the application of the competitive examination system to appointments to their offices have afterward stated frankly that the employees secured through such means were superior in qualifications to the persons they had themselves employed when in private enterprises.

For the ordinary engineering positions, for which it is desired to secure recent graduates from college, the appropriate form of examination, in the judgment of the Commission, is one covering the subjects pursued in the college course. For positions requiring supervisory or administrative ability, as well as wide knowledge and experience of any line of engineering, the form of examination prescribed is that known as the "nonassembled" examination. In connection with this form of examination, each candidate submits a sworn statement showing his education, training and experience in detail, which the commission corroborates by confidential inquiry of the references given by the candidate and of other persons having knowledge of the facts. Upon the information so secured a rating is assigned to each can-

didate by a board of examiners competent to pass upon the qualifications required in the positions to be filled.

This form of examination results in the highest type of competition, and the government has obtained through its means men of high attainment in their professions; in one such examination three state commissioners of education were candidates.

J. A. McILHENNY,
President, United States Civil Service Commission.
Washington.

Serial Bonds for Road Building

Sir—The article in your Aug. 30 issue entitled "Serial Bonds for Road Building Save Money" brings to mind the solution of a problem in annuity bonds in *Engineering News*, Nov. 2, 1916, p. 852. My solution appeared in *Engineering News*, Nov. 30, 1916, p. 1042.

In Mr. Eldridge's article no mention is made of one objection to the sinking-fund bond, and that is that these bonds usually bring the holder a higher rate of interest than the sinking fund brings the issuer of the bonds even if the money is promptly and honestly invested. The use of either annuity or serial bonds obviates this objectionable feature.

Regarding the cost of annuity and serial bonds, Mr. Eldridge does not draw a true comparison. In Bulletin No. 136 of the United States Department of Agriculture, the point is made clear that "in order to compare sums of money due at different times, they must be referred to the *same point in time*." Taking, for instance, Mr. Eldridge's examples of $100,000 4% 20-year annuity bonds shown by Fig. 3, and $100,000 4% 20-year serial bonds shown by Fig. 4, a true comparison is attained by computing the total cost at 4% compound interest of the several annual payments of each class of bonds at the end of 20 years, compounding annually.

COMPARISON OF COST—ANNUITY VS. SERIAL BONDS

Number of Years Payments Run	Compound Interest Factor (4% Annually)	Annuity Payments (Annual)	Serial Payments (Annual)	Amounts of Serial Payments at End of 20 Years, at 4% Compounded Annually
19	2.1068492	$7,358.175	$9,000.00	$18,961.64
18	2.0258165	7,358.175	8,800.00	17,827.19
17	1.9473005	7,358.175	8,600.00	16,746.78
etc.	etc.	etc.	etc.	etc.
2	1.0816000	7,358.175	5,600.00	6,056.96
1	1.0400000	7,358.175	5,400.00	5,616.00
0	1.0000000	7,358.175	5,200.00	5,200.00
Summing.	29.7774788			$219,107.14

Evidently the sum of the amounts of the annuity payments at the end of 20 years, at 4% compounded annually, is 29.7774788 × $7358.175, or $219,107.90. This comparison shows that there is a difference of only 76c. between the costs of these annuity and serial bonds—not $5163.50, as Mr. Eldridge's paper would lead one to believe.

The writer submits the following derivation for the formula given in his solution of the problem in *Engineering News*, Nov. 30, 1916, p. 1042. This formula is the one to be used in computing the equal annual payment for annuity bonds. One payment,

$$p = A\left(\frac{(b+1)^n}{b(b+1)^n - b^{n+1}}\right)$$

in which A = total debt or bond issue, or value of a single bond; b, 100 divided by the rate of interest, and n, the number of periods of time at the end of which the debt or bond issue is discharged, the interest compounding for each period.

The derivation is as follows:

$$A\left(1+\frac{1}{b}\right) - p$$

= amount at end of first year;

$$A\left(1+\frac{1}{b}\right)^2 - p\left(1+\frac{1}{b}\right) - p$$

= amount at end of second year;

$$A\left(1+\frac{1}{b}\right)^3 - p\left(1+\frac{1}{b}\right)^2 - p\left(1+\frac{1}{b}\right) - p$$

= amount at end of third year;

$$A\left(1+\frac{1}{b}\right)^n - p\left(1+\frac{1}{b}\right)^{n-1} - \ldots . - p$$

= amount at end of n th year

Then

$$A\left(1+\frac{1}{b}\right)^n - p\left[\left(1+\frac{1}{b}\right)^{n-1} + \left(1+\frac{1}{b}\right)^{n-2} + \ldots . + 1\right] = 0$$

Adding the geometrical series, where we have given the first term, ratio and number of terms, and calling 1 the first term so that the ratio is positive,

$$s = \frac{a(r^n - 1)}{r - 1}$$

we have

$$A\left(1+\frac{1}{b}\right)^n - p\left\{\frac{1\left[\left(1+\frac{1}{b}\right)^n - 1\right]}{\left(1+\frac{1}{b}\right) - 1}\right\} = 0$$

The factor by which p is multiplied in the above formula may be reduced to

$$\frac{(b+1)^n - b^n}{b^{n-1}}$$

Using this form, and substituting in the formula above,

$$p = A\left[\frac{(b+1)^n}{b(b+1)^n - b^{n+1}}\right]$$

VIRGIL A. EBERLY,
U. S. Engineer Office.
Key Bridge, Washington, D. C.

Sir—I notice that, due to the similarity of the characters 1 and I on the typewriter, you have misread the equation accompanying my letter on road bonds which you published in your issue of Nov. 1, page 849. The correct expression is:

$$\frac{1}{S_n} = \frac{i}{(1+i)^{n+1} - (1+i)}$$

R. AUSTEN McCULLOCH.
New York City.

Ethics and Engineering Salaries

Sir—Immediately after reading a letter on "Professional Ethics and Registration of Engineers" in your issue of Oct. 4, p. 657, I ran across the following in a local paper:

"None of the lumber camps is paying less than $4 a day for the commonest kind of labor, while men skilled in certain branches of timber work receive as much as $8 per day."

It seems to me that a "profession" that is paid at the rates given in the article on "Isolated Road Surveys," p. 660 of the same issue, would do well to turn its attention first to the matter of wages, even if it is necessary to make engineering a business instead of a profession to do so. It does not seem reasonable to expect a man working for $4 a day to be much concerned about "Professional Ethics." He has his own troubles finding a way to feed and clothe himself and family.

I have noticed that an engineer working directly for a business man generally gets as much pay as an "engineer" who is running a donkey engine, but that when he finds it necessary to hire an engineer to assist him he pays just as little as possible, with the desire of showing how cheaply he can do the work and with the result that engineers are held at their own valuation by more and more employers and that the larger concerns employing the most engineers pay the smallest wages.

When business men have to pay engineers—all engineers, not just consulting and chief engineers—in proportion to what they have to pay lawyers or doctors, they and the public in general will begin to recognize the engineer as a professional man, and then it will be quite natural for the engineer to set a standard of professional conduct and, in general, live up to it just as the lawyer and the doctor have done.

Dallas, Ore. S. B. TAYLOR.

Concrete Road Construction Details

Sir—In *Engineering News-Record* of Oct. 4, p. 649, the writer notes an article by P. C. McArdle on the use of a hand roller for compacting the surface of concrete roads and removing excess water. During the past season the writer developed a method for accomplishing these results, which, though decidedly simple, has proved satisfactory.

After striking off with a template the surface is rolled longitudinally with a piece of ordinary gaspipe operated by two men.

Rolling is started at the template and is continued back to the point where the surface is free from excess water. The pipe is then lifted about 2 ft. ahead and rolled back to the template. After the excess water has come to the surface another trip up and back with the roller will remove all the water and leave the surface in good condition for further finishing if it is deemed necessary. A wave of mortar is carried ahead of the roller the first time over, which fills in porous places or depressions. The second rolling removes nothing but water that is virtually clear.

This method is especially valuable when using crushed stone or slag as a concrete aggregate; the coarse material is forced down and a good surface obtained at a very small expense. After a little practice a finisher can produce a surface with the roller alone, which requires no floating. The gas pipe can be used, of course, only on flat slabs, but rolls could be made to conform to any crown desired.

In *Engineering News-Record* of Aug. 23, p. 372, there appeared an article by S. E. Fitch, on the use of concealed wooden strips for transverse joints in concrete pavements. The writer also developed this method and used it on a short section in 1916. This year it was used on a 5-mile section. The results have been very satisfactory, and the method appears to be a solution of the joint problem.

The writer believes Mr. Fitch has overlooked one very important advantage to be obtained by using this method. This is in the quality of the concrete at the joint. On most concrete roads the natural cracks are standing traffic better than the expansion joints. In

ORDINARY GAS PIPE IS USED TO ROLL CONCRETE ROAD SURFACE

striking off, the template many times carries ahead a mixture of pebbles, etc., which contain very little cement. More or less of this is carried to the joint and deposited, making a weak place where there should be the best concrete. Using a wooden strip avoids this, as the finishing can be carried ahead with no breaks for the joints, insuring a surface of uniform quality. A very fine hair crack appears over these strips after about the third or fourth day. With proper maintenance these should be better than the old expansion joint. B. F. BATCHELDER,

Chief Engineer, Portage County Improvement Association.

Ravenna, Ohio.

Blanket Application for Higher Rates

Reports that water and other utility companies of Missouri recently have been besieging the Public Service Commission for permission to increase their rates led *Engineering News-Record* to ask the commission for the facts. T. M. Bradbury, secretary, Jefferson City, Mo., has replied that only one or two water companies have appiled for increases. Continuing, Mr. Bradbury writes:

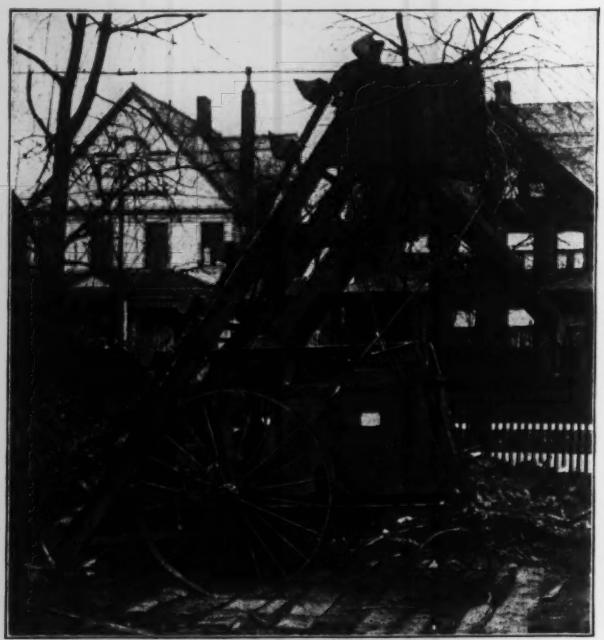
"Some time ago the Missouri Public Utilities Association, which includes in its membership some three hundred utilities in this state, comprising all water, gas, electric and street railway utilities, through one of its committees filed a request with this commission for a blanket increase in the rates of all utilities. The commission declined to make such blanket increase and suggested that the utilities make individual applications in those cases where they considered increases necessary and desirable. It was probably the above application which caused certain papers to report that a large number of companies were applying for increased rates."

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Power Loader Removes Old Dump Made in Stripping Gravel Pit

EARTH stripped by scrapers from a large sandpit in Cleveland operated by The Builders Sand Co. had been wasted at one side of the lot until it became necessary to remove it. On account of the labor shortage a power loader with a bucket chain, shown in the photograph, was employed with great success to dig down this pile of dirt and load it on trucks. With the machine 40 trucks holding about 200 yd. could be loaded in one day



UNLOADER DIGS OLD WASTE BANK AT RATE OF FORTY TRUCKLOADS A DAY

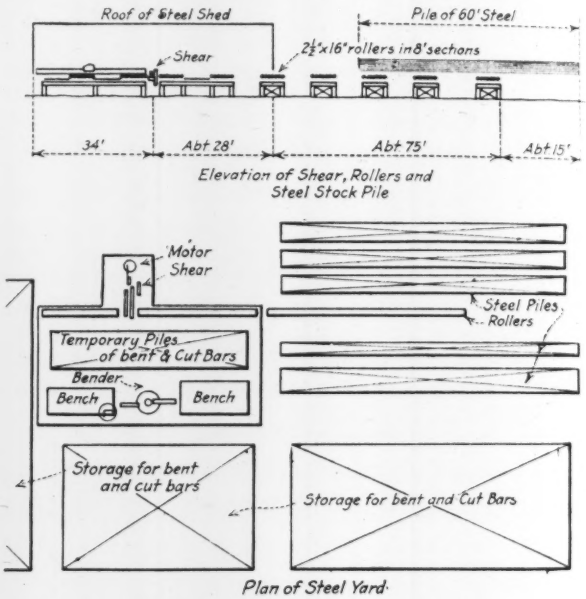
by three men, two of whom worked on the ground and one in the truck. This labor cost $10.50 per day, in addition to the expense of the truck and driver.

The machine was run by electricity and the charge for the current was very small. The Builders Sand Co. put idle trucks to work on the dirt pile, thus removing it at odd times.

Roller Conveyors Handle Long Steel Bars

SEVEN men handle 1¼-in. reinforcing bars 60 ft. long from stockpile over lumber roller conveyors to cutting shears and then to storage piles supplying the steel for a five-story addition to the plant of the Eastman Kodak Co., at Rochester, N. Y. The structure is 152 x 562 ft. in plan and requires 15,000 cu.yd. of concrete. All the steel is cut on the job.

Tables, each consisting of a frame with rollers set in the top, are placed 8 or 9 ft. apart in a line from the steel shear to the stock piles. There are 75 lin.ft. of 8-ft. roller sections used. Four men put the steel on the tables, and standing between the tables, push it forward toward the shears where three men cut it and pile the cut lengths.



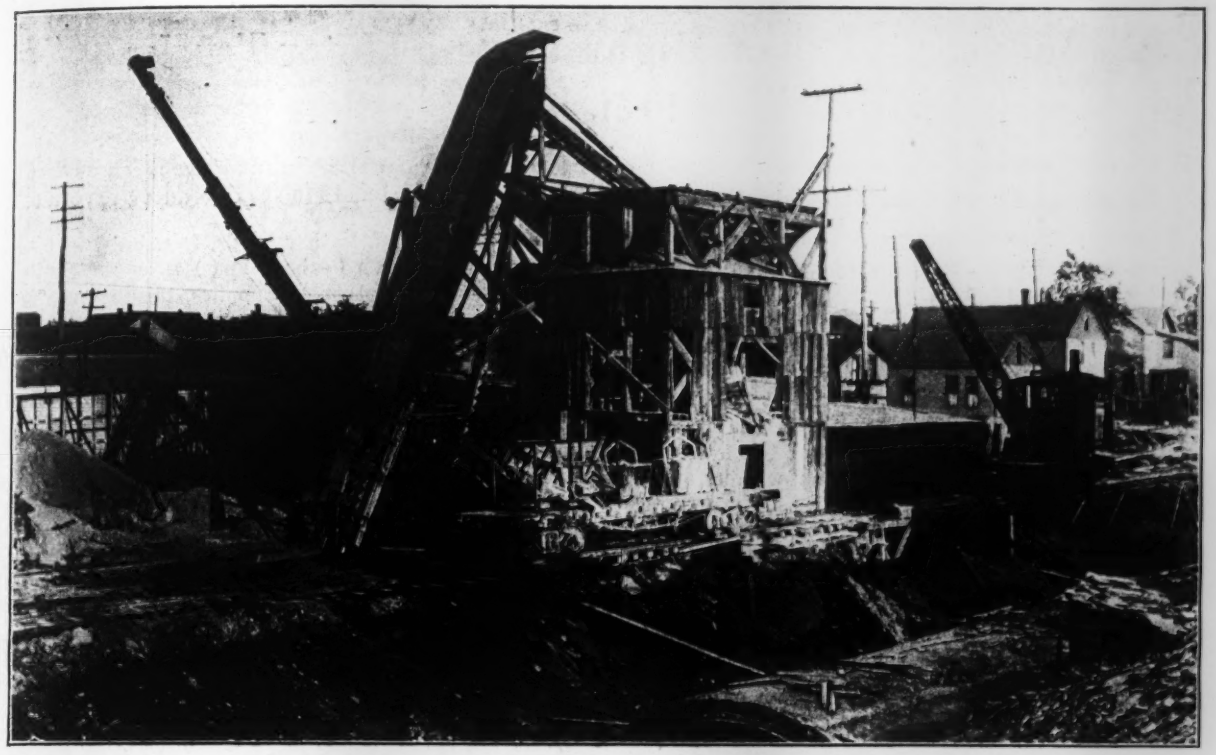
ROLLERS LIGHTEN WORK AND KEEP GANG ON JOB

Across the shed from the shear is a power bender which makes two bends at once on the truss bars for the beams. The bent and straight bars are tagged and the different types are stacked in separate piles in the storage space around the steel shed.

The building is being erected by the Ferro-Concrete Construction Co., for which Stacy Campbell is superintendent.

Buckets and Spouting Hopper on Flat-Car Place Sewer Concrete

ON THE flood protection work at Erie, Penn., concrete for the invert of the large culvert which is to replace Mill Creek is carried in the hopper mounted on the flat-car shown in the photograph, and is spouted to place. The outlet of the hopper is a hand-controlled gate, and the hopper is used for placing the invert, which is, of course, concreted first, and also for any other work where it is desired to keep the flow of concrete under close control. The hopper holds about 3 yd. The flat-car on which it is carried has room also for several concrete buckets, which can be handled by the crane. The photograph shows the flat-car at the central concrete plant, where buckets and hopper are loaded by spotting them under the discharge from the large hopper into which the mixer dumps. The buckets are



HOPPER ON CAR GIVES EXTRA CAPACITY AND MAKES SPOUTING FOR SEWER INVERT POSSIBLE

double-line affairs, dumped under the control of the crane operator. The car is handled from the mixer plant to the point of concreting by the locomotive crane which dumps the buckets.

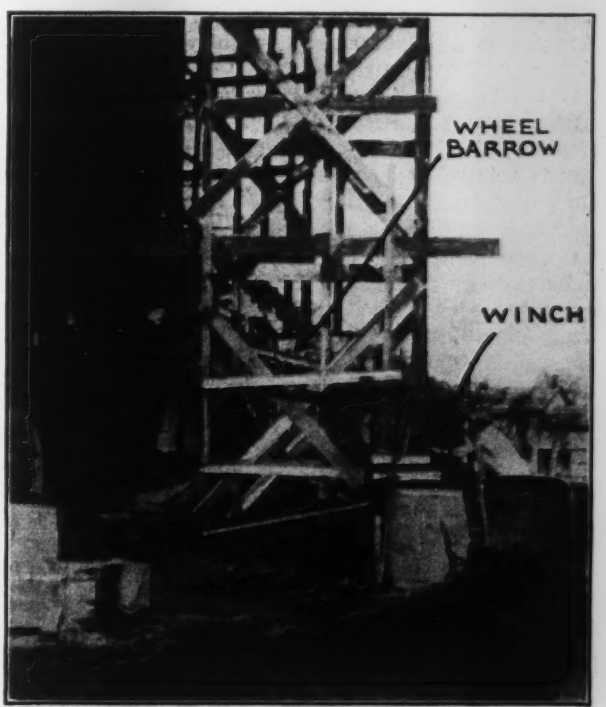
The hoist also handled several tons of stone used as trim on the tower. Since the hoist was well braced to the scaffolding, it was not necessary to use guys of any kind.

Corner of Scaffolding Turned Into Brick Hoist for Building Steeple

By J. J. Grossman
Fort Edward, N. Y.

IN PUTTING up a 60-ft. brick tower which the writer added to a church building recently it developed that the small quantity of brick did not warrant the installation of a building hoist, and also that hod-carriers appear to be extinct. The difficulty was solved by placing two additional poles at the corner of the scaffolding, putting in a pair of guides between the scaffolding poles and the extra poles, and using a hoisting sling for raising wheelbarrow-loads of brick and mortar. The four poles which formed the hoist-way were carried about 10 ft. in advance of the rest of the staging, a head-block with a single block was secured across the top and a wire rope run through the head-block to an ordinary winch fastened to one post of the tower at the ground. The wheelbarrow sling, attached to this rope, was used to raise all brick and mortar in an ordinary wheelbarrow. The load was swung out and landed directly on the scaffolding and wheeled to the men, eliminating all rehandling.

With this arrangement, having two men on the ground, one of whom turned the winch and the other loaded the wheelbarrows, and a third man on the staging to wheel the material to the bricklayers, it was possible to keep five masons going.



USING THIS HOIST THREE MEN SUPPLIED BRICK AND MORTAR TO FIVE MASONS

Industry's Use of Highways and Motor Trucks To Relieve Freight Congestion

Engineering News-Record's Inquiry Brings Replies from Manufacturers and Trucking Companies Throughout Country—Many Firms with War Contracts Use Roads for Raw Material and Finished Product Delivery

IN CONNECTION with Priority Order No. 2, effective Nov. 1, prohibiting the use of open-top railroad cars for the transportation of materials necessary for the building and maintenance of highways, *Engineering News-Record* has secured from manufacturers and truck users in various sections of the country evidence to support the claim that good roads at this time of railroad congestion are of vital importance to the industrial life of the nation. Two series of telegrams were sent out, one to a selected list of manufacturers and the other to a list of trucking companies. The two telegrams are as follows:

TO MANUFACTURERS

"Will you wire press rates answers to following questions, so we can estimate war value of highways: (1) Are you using trucks over country highways as relief for railroad congestion? (2) What materials are you hauling and between what points? (3) Are bad roads interfering? (4) How serious would it be for your business if you had to rely solely on railroads? (5) Would better highways help? (6) How? (7) Are you handling war orders?

"ENGINEERING NEWS-RECORD."

TO TRUCKING COMPANIES

"Will you wire press rates answers to following questions, so we can estimate war value of highways: (1) Are you operating trucks over country highways as relief for railroad congestion? (2) How many trucks? (3) What size? (4) Between what points? (5) Are poor roads interfering with your business? (6) How would the business of your clients be affected if they had to rely solely on railroads? (7) Are you hauling for any war industries? (8) Can trucks and highways help relieve railroad congestion materially?

"ENGINEERING NEWS-RECORD."

From the replies, the following digest is presented:

While all the manufacturers replying from the New England territory are not using motor trucks, those that are testify to the service rendered by these vehicles in the present traffic-congestion emergency. It is significant that one of the replies states that motor-truck delivery is proving cheaper than delivery by common carrier. Another manufacturer states: "It would be almost impossible for us to do business if we had to rely solely on the railroads." It is noticeable from the New England replies that manufacturers find the highways in that section well built and maintained.

Menomac Mills, at Lawrence, Mass., which has war contracts to fill, is not using motor trucks and has little complaint to make of the slow delivery on the part of the railroads. In its case, according to its statement to *Engineering News-Record*, better roads would not help.

The A. C. Lawrence Leather Co., South Boston, Mass., on the other hand, which is handling large army contracts for shoes and leather goods, is using two 5-ton motor trucks between Peabody and Boston for hauling finished leather and tannery supplies, the distance one way being 20 miles. The company reports that the use of motor trucks is an advantage and that costs are somewhat less than those by public carrier, when the pick-up and delay at each end are taken into consideration. One of the great advantages of the motor truck, the company has found, is its ability to give overnight delivery. The roads between Peabody and Boston are reported to be good and the company contemplates year-round operation.

In handling big contracts for army equipment, Warner Bros. Co., Bridgeport, Conn., are using motor trucks, and have found all of the state highways in good condition, the routes used being between Bridgeport, Danbury and Stamford. Without good roads and motor trucks, the company reports, serious inconvenience would be caused in delivery to its out-of-town branches.

Although it is handling large war orders, the Norton Grinding Co., Worcester, Mass., is not employing motor-truck delivery as relief for railroad congestion.

"It would be almost impossible for us to do business if we had to rely solely on railroads." This is the statement received from S. J. Townsend, traffic manager of the Brockton (Mass.) Heel Co., which is making deliveries of its products to the War Department. This concern is using motor trucks between Boston, Brockton and other suburbs within a radius of 20 miles for the delivery of sole leather, heels and soles for shoes. Bad roads, it is claimed, are interfering with deliveries.

The Pratt & Cady Co., Inc., Hartford, Conn., manufacturers of valves, hydrants and other fittings, is not handling any war orders and has not found it necessary to use motor trucks to transport material over state highways.

MIDDLE WEST REPORTS RAILROADS INADEQUATE

Four replies were received from the Middle West, as represented by Ohio and Illinois. The Red Line Carting Co., Akron, Ohio, which is doing a big freight-transportation business by motor truck between Canton and Akron and Akron and Cleveland, reports that if its clients depended solely on the railroads they would be swamped. Poor roads, the Red Line Co. reports, are interfering somewhat with motor-truck operation, although this concern has five trucks on the road.

The Knutsen Motor Trucking Co., Cleveland, is doing a haulage business in connection with war industries. It has 25 trucks in service, ranging in capacity from 3 to 6 tons. These trucks are hauling coal from mines to manufacturing plants at Wheeling, W. Va.

"We are operating trucks over country roads," wires the Ohio Freight Delivery Co., of Cleveland, "not only as a relief to freight-congested districts, but for the

amount of revenue derived therefrom. Our service spells door-to-door delivery, from the shipper to the consignee—direct service the same day. We have twenty-five 4-ton trucks on order and are also operating 1- and 2-ton equipment at all of our stations, located at Cleveland, Lorain, Elyria, Akron, Norwalk, Sandusky, Toledo and Canton. These are in operation on a regular daily schedule. If the condition of the roads permit we will, no doubt, extend this kind of service throughout the country. The Ohio Freight Delivery Co. has applied itself as the medium between the freight and express.

"Trucks and good highways are evidently the only means of remedying conditions that now prevail, and the public are demanding service, other than freight service."

From Chicago, S. Inlander & Co. report use of trucks, not necessarily to relieve railroad congestion, but in the regular course of the business of hauling wrapping paper between Chicago and points 25 miles distant. No interference with truck service on account of bad roads has been experienced. The company is not handling war orders and has never had to rely solely on railroad transportation.

Daily Trips Between Philadelphia and New York

Replies from New Jersey and Pennsylvania indicate a widespread dependence on motor trucks for freight.

The Stedman Bent Co., Philadelphia, is operating twelve 5-ton trucks daily between Philadelphia, Chester, Wilmington, Baltimore, Bristol, New York, Trenton, Lancaster, Plainfield, Bayonne, Bethlehem, Allentown and intermediate points. This firm, which is doing hauling for war industries, believes that good roads are essential in this time of railroad congestion and will become more necessary when short-haul zones are abolished by the railroads.

For hauling coal between Hite and Glassmere, Penn., the Allegheny Plate Glass Co. is using motor trucks as a relief for railroad congestion. "Our business would be closed down if we had to depend on railroads," says a telegram from this concern.

The R. H. Comey Co., Camden, N. J., has found railroad freight service so uncertain and unsatisfactory that if it were not for motor-truck transportation between New York and Camden, its plant, which manufactures straw hats and dyes large quantities of wool and cotton for army uniforms, would be closed down. While the roads used are reported to be in fairly good condition at the present time, it is believed that the increased traffic which they will have to carry will destroy them unless adequate maintenance work is carried on.

The following telegram has been received from the H. K. Mulford Co., Philadelphia:

"For the past year we have used motor trucks to relieve the railroad congestion, principally between Philadelphia and New York. We find this service more expensive than freight, but it has enabled us to complete Government contracts and forward emergency supplies, such as antitoxins for tetanus and diptheria serum for pneumonia, dysentery, typhoid and vaccine for smallpox needed by our allies and more recently by our own Government. It is necessary that some method of relieving the present railway congestion be practiced and we believe the motor truck is the only means of taking up this shortage at many points. Between Philadelphia and New York the condition of the roads is almost unbearable, causing serious delay in the running schedule and adding material expense for maintenance and repairs. Better highways would not only help to relieve the present transportation difficulties, but would be absolutely necessary as a war defense measure."

Almost Equal Express Rates

The experience of the Beam Fletcher Corporation, Philadelphia, is embodied in the following dispatch:

"We are giving daily motor-truck express service between Philadelphia and New York; also making trips to all parts of nine eastern states by special arrangements as relief for railroad congestion. We are giving 12-hour service between Philadelphia and New York at rates almost equal to railroad express rate. Our present fleet consists of 22 five-ton White trucks, but this number will be increased next week by 10 more of the same kind and size, now in transit. Roads between Trenton and Newark not very good, but the present condition is not interfering with our business. Our customers would be sorely handicapped if they had to rely solely on railroads, as we are hauling such commodities as require much quicker delivery than railroads and express companies can possibly give, such as export shipments, foodstuffs, chemicals, machinery, clothing, munitions.

"Only large fleets of dependable motor trucks, backed up by experienced organizations, can help relieve the railroad congestion. For example, we can move over 400 tons of freight a day between New York and Philadelphia. As soon as we receive delivery of the balance of our fleet of 32 five-ton White trucks we can give faster service between Boston and Washington, D. C., than express companies can.

"New Jersey's new motor-vehicle law, reducing speed of trucks to 10 miles per hour with sealed governor will, if enforced, make it unprofitable for us to continue operations east of Pennsylvania after Jan. 1."

Railroad congestion has forced the A. B. Kirschbaum Co., Philadelphia, to resort to motor-truck haulage for carrying machinery and uniforms for the U. S. Army between Philadelphia and Reading, where one of its large factories is located. The company is also using motor trucks for shipments between Philadelphia and New York for its civilian business, because of congestion and delays by freight and express. The roads used are reported to be in fairly good condition, although no prophecy is made as to how long they will continue to stand up under the greatly increased service. They telegraph: "If we had to rely solely on railroad service at this time it would be most serious for us and the Government."

Both to relieve car shortage and as a matter of economy, the Alfred Struck Co., Louisville, Ky., is using a number of trucks and trailers of various makes. The trucks are used principally for the delivery of silos, weighing from 6000 to 16,000 lb. each. Forty miles is considered the economical truck limit. The company is not doing any hauling for war industries other than its own work of erecting 29 buildings for the Quartermaster Depot at Jeffersonville, where trucks are used to receive material unloaded from cars.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

High Bids Made for Channel Widening at Columbus

Lowest Exceeds Estimated Cost by 22 Per Cent.—City Likely to Modify Plans

Service Director Borden on Nov. 13 opened bids for the $1,900,000 river-channel widening work at Columbus, Ohio, which was recently authorized by city and state authorities. Only three bids were received for the work, and all of them were much above the estimate. After a conference with council committeemen, Director Borden said he would reject all the bids received and solicit another bidding on modified plans.

The three bids were as follows: J. B. Sheets & Co., Pittsburgh, for the work, with concrete balustrade, $2,358,859; with stone balustrade, $2,361,379; Robert H. Evans Co., Columbus, with concrete balustrade, $2,600,349.65; with stone balustrade, $2,616,537.50; W. E. Callahan Construction Co., Omaha, with concrete balustrade, $2,248,811.25; with stone balustrade, $2,262,979.50. The lowest bid is approximately 22% above the estimated cost.

Other large contractors were present, but did not bid because of the uncertainty of present conditions and the cost of labor and coal. One company notified Mr. Borden that it is fully equipped to do the work, but that it does not care to submit a bid. This company expressed its willingness to bid on a percentage basis in case the bids were thrown out.

It is proposed to modify the conditions by decreasing the yardage of excavation from the channel and substituting a cheaper material, below the water line, for the concrete revetments at curves in the channel. It is said that the changes would reduce the cost by more than $200,000. It is admitted that the decrease in excavation would lessen the security from flood, but not seriously, it is said. Any change in plans will have to be approved by the council.

Chicago Fruit and Vegetable Terminal Project Dropped

After waiting in vain two years for a permit from the city council to build a fruit and vegetable terminal in Chicago, the Atchison, Topeka & Santa Fe Ry. has withdrawn its application. Although the company is said to have been acquiring the property for 30 years, and has paid more than $4,000,000 therefor, it has apparently abandoned the project as hopeless.

The general plan was described in *Engineering Record* of June 26, 1915.

Engineers' Part in the War Will Be Keynote of M. E. Meeting

"The Service of the Engineer to the Public in Times of Crises" will be the keynote sounded at the annual meeting of the American Society of Mechanical Engineers, to be held Dec. 4-7 at its headquarters, 29 West 39th St., New York. On the opening day honorary membership in the society will be conferred upon Maj. Gen. George W. Goethals, and this ceremony will be followed by an address by former President William H. Taft.

At the "Keynote Session," to begin at 10 a.m., Dec. 5, Dr. Ira N. Hollis, president of the society, will deliver an address on "Universal Public Service in Peace and War." He will be followed by Gano Dunn, president of the J. G. White Engineering Corporation, New York, who will speak on "The Engineering Societies in the National Defense"; Dr. Charles S. Howe, president of Case School of Applied Science, "Special Education in Time of War"; C. E. Skinner, Westinghouse Electric and Manufacturing Co., Pittsburgh, "Engineering Research"; William P. Kennedy, consulting engineer, New York, "Motor Transportation"; Maj. L. B. Moody, Ordnance Department, United States Army, "Army Transportation"; Leonard Metcalf, consulting engineer, Boston, "The Solution of the Cantonment Construction Problem"; and others.

At the industrial-safety session, on the same day, two codes will be presented for discussion by the Subcommittee on Protection of Industrial Workers, of safety standards for elevators and woodworking machinery.

Engineer Detachment Needs Draftsmen, Clerks and Stenographers

There is being organized under the direction of Lieut. A. P. Morris, Room 195, office, Chief of Engineers, War Department, Washington, D. C., a depot detachment consisting of draftsmen, stenographers and clerks for service at army headquarters in France. It is expected that the first one hundred men will leave about Dec. 1, the balance following as soon as organized. It is necessary that the men forming the detachment go on a military footing, hence the detachment will be organized as follows:

One hundred and forty draftsmen, topographical, architectural and mechanical, with pay ranging from $96 to $51.20 per month; 180 stenographers and typists, $40.80 to $36.60; 80 clerks, $33; 28 master engineers, senior grade, $96; 32 master engineers junior grade, $84; 28 sergeants, first class, $60; 64 sergeants, $51.20; 60 corporals, $40.80; 52 privates, first class, $36.60; 136 privates, $33.

These men must be experts, and advancement will depend entirely upon the man, within the limits indicated above. Applications should include answers to the questions given below and be accompanied by letter giving in detail experience, also recommendations where possible:

Have you been called by local board? Have you been exempted or claimed exemption? Have you been called by local board to report for service? On what date have you been ordered to report? What is your serial number? What is your order number? What is your local board number?

Address all communications to Lieutenant Morris.

State Highway Officials To Hold Annual Meeting

The American Association of State Highway Officials will hold its annual meeting at the Hotel Jefferson, Richmond, Va., Dec. 4, 5 and 6. The program and discussion are open only to members of the association and those eligible to membership.

President C. P. Coleman, of Virginia, will deliver the opening address, his topic being "Present Conditions Affecting Road Construction and Measures Taken to Meet Them." W. D. Uhler, of Pennsylvania, will discuss conditions in the East; S. E. Bradt will speak for the Central West; W. S. Keller, for the South; and a fourth speaker will deal with the situation as its exists in the Far West.

Car shortage, military roads, the Federal-aid road law and other subjects are scheduled for later meetings, the speakers being Charles D. Upham, of Delaware; Col. William D. Sohier, of Massachusetts; Logan Waller Page, of Washington, D. C.; and T. H. MacDonald.

The last day's sessions, Dec. 6, will be devoted to papers and discussions on practical road-building and maintenance topics. These men will speak: H. Eltinge Breed, of New York; H. G. Shirley, of Maryland; F. F. Rogers, of Michigan; Paul D. Sargent, of Maine; John H. Mullen, of Minnesota; and W. S. Gearhart, of Kansas.

Changes at Fort Leavenworth

The work of the engineer reserve officers was brought to a close at Fort Leavenworth, Kan., the day before Thanksgiving. The Fifth Provisional Battalion of 1200 men arrived at the fort for training Nov. 26.

Harris Succeeds Capps as Manager of Fleet Corporation

Rear Admiral Frederick R. Harris, Chief of the Bureau of Yards and Docks, U. S. Navy, has been detailed as general manager of the Emergency Fleet Corporation, vice Rear Admiral W. L. Capps, Naval Constructor, U. S N., whose resignation was accepted by the President on Nov. 23.

Admiral Capps succeeded Major General Goethals in the position early in the summer and has been working since that time beyond his strength. He asked to be relieved on account of physical disability and this request was acceded to by the President on that ground. It is reported that the position was offered to Homer L. Ferguson, president of the Newport Shipbuilding Co., but that he declined. Chairman Hurley, of the Shipping Board, wrote Secretary Daniels, testifying to the value of Admiral Capps' services and requesting that the Secretary suggest the name of some naval engineer or constructor as his successor.

Admiral Harris is head of the Corps of Civil Engineers of the Navy and as Chief of the Bureau has made an enviable record in prosecuting the enormously enlarged work of the Bureau since the war. He is a graduate of Stevens Institute, class of 1896, and before entering the navy in 1903 had considerable experience in design and construction, mainly in connection with harbor projects. His notable assignments in the service were the naval station work at Guantanamo, Cuba, and the construction of dry dock No. 4 in the Brooklyn Navy Yard.

Admiral Harris will retire from the Bureau of Yards and Docks, but the new chief has not as yet been announced.

Highways Transport Committee Begins Its Work

The newly created Highways Transport Committee of the Council of National Defense, of which Roy D. Chapin, president of the Hudson Motor Car Co., is chairman, has begun work in Washington, with headquarters in the Munsey Building. R. C. Hargreaves, who has been working with the Storage Committee of the Council, has been appointed secretary, and two field agents have been sent out to make a detailed study of traffic congestion at terminals.

"We have established contacts with the various government departments," Mr. Chapin said in Washington the past week to the representative there of *Engineering News-Record*, "and we have been requested to supply certain pieces of information, upon which we are working. No policies have yet been decided upon, nor shall we will be able to announce the personnel of an enlargement of the committee, which has been under consideration, until we find just what work we shall be obliged to do. When we do find out that, we shall select the men best fitted to carry it out."

A statement by the committee is in part as follows:

"Gen. Chauncey Baker, U. S. A., in charge of army transportation, has requested that the committee have the highway from Detroit, Mich., to Newport News, Va., put in the best possible shape for a run soon to be made by a quartermaster motor truck train. This trip will be made as a preliminary investigation as to the feasibility of bringing over the highways of the country after Jan. 1 the thousands of standardized trucks destined for France. The first trip will be made by a regular truck company of thirty trucks with full personnel. The men will encamp each night at whatever spot the train finds itself at the end of the day's run."

The committee, it may be stated, is preparing for the War Department an elaborate system of maps of the United States, showing motor truck routes, short runs, and spots where road building will be necessary to connect up chains of highways.

The Official Bulletin says it is not the purpose of the newly appointed Highways Transport Committee of the Council of National Defense, in urging the great utility of motor trucks for carrying freight short distances, to operate any motor transportation; rather, through a continuous study of present problems, and coöperation with other transportation agencies, to bring into its fullest use the possibilities of the motor truck for carrying of freight over distances where it can prove its economy and helpfulness in the present emergency.

City Managers Hold Annual Meeting at Detroit

Engineers Predominate in Fourth Experience Convention of New Profession

The fourth annual meeting of the City Managers' Association, held at Detroit last week, was chiefly an experience meeting, but a few outside speakers and some committee reports gave it a cast somewhat different from that of the earlier conventions. The City Managers' Association was one of a number of organizations, including the National Municipal League, the Society for Training for Public Service and the Municipal Research Conference, which joined in a "municipal week."

The high mortality rate among city managers was mentioned by Ossian E. Carr, city manager of Niagara Falls, Ont., in his presidential address. The association now has only four of the members it had at the time of its organization, four years ago (but it should be noted that the membership was very small at that time). Some of the 1916-17 losses in city managers, Mr. Carr said, are apparently due to popular dislike of commercial practice applied to public business.

A suggestive committee report on city management as a profession was presented by H. M. Waite, Dayton, Ohio. The commissions of a number of cities have made a city manager profession by going to other cities for their managers. There are now seven managers who have gone from one to another managership. That engineers are recognized as qualified for the position of city managers, Mr. Waite said, is shown by the fact that of the 25 managers registered at the meeting this year about 90% were engineers.

City Managers' Qualifications

Dividing cities into three classes, the following general qualifications for city managers were suggested: Cities under 20,000 population, executive ability and engineering experience; 20,000 to 200,000, executive ability, with engineering experience of less importance; over 200,000, executive ability the prime essential.

Actual experience in the work is the best preparation for a city managership. Attempts at producing a city manager by education are hampered by the fact that executive ability, which is the prime essential, cannot be taught in the schools. So far as the schools are concerned, education had better be inculcated primarily along the line of the natural bent of the candidate, such as engineering, with some general instruction in the whole range of municipal topics.

Formal Papers a Departure

Contrary to the practice at earlier conventions, this year's program contained a few formal papers by men not city managers. A review of paving experience at Ann Arbor, Mich., which, among other things, outlined the rise, the flourishing period and the decline of Dollarway pavement in that city, was read by Manley Osgood, city engineer.

A paper on "City Planning for Small Cities, with Special Reference to Industrial Surveys," was sent by E. P. Goodrich, consulting engineer, New York City. The need for efficiency in the industrial sections of our cities in war times was emphasized. The situation demands a plan and that requires a survey. A small city has an advantage over a large one in that it can profit from the lessons taught by the larger cities and plan aright when the city is in the making.

Will Manager Plan Fit All Cities?

At a joint luncheon conference with the National Municipal League there was an extended discussion of the question: "Will the City Manager Form of Government Fit All Cities—Large Cities—Machine-Controlled Cities?" The consensus of opinion was in the affirmative. In fact, it was even urged that the manager form of government was in some respects better suited to large cities than small, because the manager of the large city might be chosen for managerial ability alone and could pick

a staff of specialists, while the manager of a small city must combine in one person some knowledge of many specialties. A machine-run city, it was also urged, would be better run under the manager than the old plan. The negative side of the question was taken by George B. Harris, chairman of a political county committee, who contrasted the present governments of Cleveland and Dayton, with the intention of proving that Dayton had nonrepresentative and Cleveland representative government. The bulk of the voters, nearly all the "toilers," do not want efficient or business government, he maintained, because they think such government is not conducted in their interest but for the benefit of other classes.

In another connection, Gaylord C. Cummin spoke against administrative boards. If there is something to be done, he said, hold one man responsible for doing it.

Economy Not Enough

"Now That We Have the City Manager Plan, What Are We Going To Do With It?" the title of a paper by R. S. Childs, secretary, Short Ballot Association, sounded the keynote of the whole meeting, viz., that economy and efficiency are not enough to insure success in city administration. Mr. Waite said the very newness of the plan had carried them along so far, but would do so no longer. It now depends on the city manager. He must accomplish more and discover new ways of getting closer to the needs of the citizens, but none of these things can be done nor should be attempted until the idea has been "sold" to the public. Much use was made of this word "sell." Mr. Waite explained that it was necessary to impress on the public continually that a proposition was being "sold" to them, but at a fair price. If the public wants two ash collections a week, sell it to them only after they are fully aware of the cost.

Democratic government, Mr. Waite explained, does not require a large council or commission but a small workable one, representing a true cross-section of the voters.

The tendency of managers to be official and cold must be overcome. They must travel along common-sense, human lines. "Do not preach too much about the money saved, but spend it on something else the people want," was Mr. Waite's advice.

The Winning of Publicity

Publicity is becoming a harder problem, for the dailies in small towns are being consolidated, 68 in Michigan having been reduced one-half in number since the war began. Whether the opposition paper or the one friendly to the administration was left proved almost equally bad for the city manager.

Many cities, said H. M. Waite, are spending large amounts to survey and investigate every kind of activity except the public utilities. Antagonisms arise from lack of service; funds are not available to the utility to make the needed expansions; securities shrink, and the service sinks still lower. Dayton employed an expert to discover where the utilities were headed. Mr. Waite urged every manager to protect the financial basis of the property, avoiding duplication, and to protect the investment already made if adequate service is to be obtained.

G. O. Nagle, Wheeling, W. Va., feels that the local transportation utilities have been going backward for five years and are fast getting into the same financial position as the railroads. He attributes some of the trouble to the increasing powers of state commissions supplanting home rule.

Five Towns Want Managers

Sault Ste. Marie, Mich., Santa Barbara, Calif., Albuquerque, N. M., Xenia, O., and Altoona, Penn., are looking for managers, it was announced.

Circulation of a mimeographed paper among the managers once a month is to be a feature used to get new members for the Association.

The officers elected for the ensuing year are as follows: President, Gaylord C. Cummin; vice-president, C. A. Bingham; secretary-treasurer, H. G. Otis, Beaufort, South Carolina.

Cantonment Builders Pay a Tribute to Major Myers

To indicate their appreciation of the way the army cantonment construction at Camp Upton, Yaphank, N. Y., was handled, members of the engineering, contracting and accounting organizations connected with the work, to the number of several hundred, gave a dinner Nov. 24 at the Harvard Club, New York City, to Maj. O'Kelly Myers, U. S. R., constructing quartermaster. Louis J. Horowitz, president of the Thompson-Starrett Co., the contractors for Camp Upton, acted as toastmaster, and among the engineers who spoke were J. Waldo Smith, chief engineer of the New York Board of Water Supply, James B. Lippincott, consulting engineer and formerly assistant chief engineer of the Los Angeles aqueduct; Robert Ridgway, engineer of subway construction, Public Service Commission, and James F. Sanborn, acting department engineer on the city aqueduct of the Board of Water Supply, who assisted Major Myers in organizing the engineering staff of Camp Upton. At the termination of the dinner Donald W. Howes, engineer of the construction at the camp and principal assistant to the constructing quartermaster, presented to Maj. Myers, on behalf of his associates, a silver service. Major Myers, in the closing address, paid high tribute to the members of his staff and to the contractors.

The committee which arranged the dinner consisted of A. V. Dillon, for the auditor's staff; W. S. Timmis, for the consulting engineers; W. M. Affelder, for the Thompson-Starrett Co., and M. M. Farley, for the engineers of construction.

Joint Committee Unable to Solve West Side Problem

Failure to effect a settlement of the West Side freight problem in New York City is acknowledged by the joint committee of the city's Board of Estimate and the State Public Service Commission, First District, in a statement issued last week by Charles S. Hervey, of the commission. The time allotted to the joint board expires Dec. 1, and the committee has found the New York Central R.R. unwilling to consider any proposal departing from the tentative agreement of 1916. The committee, on the other hand, will not approve that agreement, as it believes such action would permanently establish the company's right to its occupancy of the city streets.

The committee contends that the company has no rights that are not revocable. It has asked the Board of Estimate to repeal the ordinance of 1847 and subsequent ordinances, on which, it holds, the company depends for its continued occupancy of the streets. The committee sought this to give the Public Service Commission a free hand when it takes sole jurisdiction Dec. 1. The board, however, has declined to do more than refer the matter to the corporation counsel for an opinion.

The company and those city officials who backed the tentative agreement of 1916 base their attitude on what they regard as the irrevocable rights of the company, definitely upheld by the courts.

Expect Heavy Motor Truck Traffic in Pennsylvania This Winter

The automobile division of the Pennsylvania State Highway Department already has received more than 5100 applications for 1918 motor vehicle registrations and licenses, the moneys therefrom totaling $40,835. In view of the anticipated all-winter transportation over the main state highways by big motor trucks, all corporations, manufacturers, department stores and other organizations using many trucks and automobiles are especially urged to present soon their applications for 1918 license plates.

Government in Need of Cement Testers and Inspectors

The purchase of enormous quantities of cement by the Government in the present emergency has created an urgent need for experienced cement testers and inspectors in the testing laboratories of the Bureau of Standards. The Civil Service Commission has therefore announced a registration of eligibles for appointment to these positions at salaries of $900 to $1000. Qualified applicants are requested to communicate at once with the Civil Service Commission, Washington, D. C., for detailed information.

Cameron Septic Tank Case Again in Court

To assist in the defense of the suit which the Cameron Septic Tank Co. has brought against the City of Shelbyville, Ky., for alleged infringements of the Cameron septic tank patents, Clyde Potts, civil and sanitary engineer, of New York City, has been engaged by Wallace R. Lane, attorney, of Chicago, who is handling the case for the city. Mr. Lane also represented Knoxville, Iowa, in the Cameron patent litigation. That case was carried to the Supreme Court of the United States and the court held in that suit that the Cameron patents expired with the English patents in 1909, and that the treaty of Brussels did not extend the life of the patents to the full 17 years, as the Cameron company asserts.

Tennessee River Bridge Opened

The Market Street Bridge across the Tennessee River at Chattanooga, Tenn., was formally opened on Nov. 17. The formal opening exercises were conducted under the direction of the Chattanooga Auto Club.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, 29 West 39th St., New York; Jan. 16 and 17, 1918, New York; Charles Warren Hunt, secretary.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York; Dec. 4-7, New York; Calvin W. Rice, secretary.

GENERAL CONTRACTORS' ASSOCIATION; 51 Chambers St., New York; Dec. 8, New York; C. A. Crane, secretary.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, 35 Nassau St., New York; Jan. 14, New York; F. A. Molitor, secretary.

NEW ENGLAND WATER-WORKS ASSOCIATION; 715 Tremont Temple, Boston; Jan. 9, Boston; Willard Kent, secretary.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Richmond, Va.; Dec. 4-6, Richmond, Va.; Joseph Hyde Pratt, secretary, Chapel Hill, North Carolina.

AMERICAN WOOD PRESERVERS' ASSOCIATION; Baltimore, Md.; Jan. 22-24, Chicago; F. I. Angier, Baltimore & Ohio R.R., Mount Royal Station, Baltimore, Md., secretary.

CANADIAN SOCIETY OF CIVIL ENGINEERS; Montreal; Jan. 8, Montreal; Fraser S. Keith, 176 Mansfield St., Montreal, Can., secretary.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS; Dec. 27-29, Chicago; C. K. Shedd, Ames, Ia., secretary.

The Brooklyn Engineers' Club held an informal meeting on Nov. 22, at which several speakers gave talks on "War Technical Work by Engineers," illustrated by lantern slides. The principal speakers were John A. Bogart, consulting engineer, who described his design for a nonsinkable ship with hydro-aëroplane accommodations; William T. Donnelly, consulting engineer, who explained his designs for a torpedo-proof steel ship and his economical design for wooden ships; Howard T. Quick, consulting engineer, who explained his ideas for combating submarines by means of a concealment device for ships and also devices for detecting moving periscopes and torpedoes.

The Municipal Engineers of the City of New York, at a meeting held Nov. 28, listened to a paper on "Smoke, Its Cause, Effect and Remedy," presented by Joseph M. Lonergan, assistant director, Sanitary Bureau, Department of Health, New York City. The paper was illustrated with lantern slides.

The Oregon Society of Engineers met at Portland, Nov. 15, and was addressed by A. L. Barbour, commissioner of public works, Portland, on "The Needs for a Complete Cost-Keeping System in City Departments."

At a meeting of the **Canadian Society of Civil Engineers,** Nov. 22, Lieut. Col. C. N. Monsarrat, chairman of the Quebec Bridge Commission, delivered a preliminary address, illustrated by slides and motion pictures, on the Quebec bridge. This was the first of a series on this subject to be presented to the society.

At the group meeting of the **Rochester, N. Y., Engineering Society,** Nov. 16, the subject for discussion was "Contracts." The discussion was led by John F. Ancona, consulting engineer.

The Idaho Society of Engineers met in Lewiston, Nov. 12-13. Dr. C. N. Little, dean of the College of Engineering, Idaho State University, presided. R. N. Bell, state mine inspector, spoke on "The Contribution of Idaho's Mines to the Support of the War"; Dean Francis A. Thompson, of the School of Mines, presented the subject "Common Sense in Mining"; S. E. Vance, of the state engineer's office, spoke on "The State Management of the Distribution of Water." Other speakers were R. A. Foster, president of the Lewiston-Clarkston Improvement Co., and R. H. Mann, engineer for the Lewiston Orchards Company.

At the annual dinner of the **Harvard Engineering Society of New York,** to be served at the Harvard Club, Dec. 6, the guest of honor will be President Ira N. Hollis, of Worcester Polytechnic Institute. Other speakers will tell of war conditions "over there."

The Kansas City Chapter of the American Society of Heating and Ventilating Engineers, organized in January, holds monthly meetings. The chapter has about 40 members. The officers are: F. A. De Boos, president; John H. Kitchen, secretary, 311 New England Life Building, Kansas City, Missouri.

The Engineers' Club of Seattle, at a special meeting Nov. 13, entertained William C. Edes, chairman of the Alaska Engineering Commission. Mr. Edes spoke on "The Present Status of the Government Railway Project in Alaska," saying that before the end of next season the first regular train service over the coast end of the railroad will be established.

PERSONAL NOTES

PROF. J. MADISON PORTER, after 28 years as head of the department of civil engineering at Lafayette College, has given up his teaching work to devote himself to his interests in other lines. He is succeeded by PROF. A. H. FULLER, heretofore dean of the engineering school of the University of the States of Washington.

BRIG. GEN. FREDERIC V. ABBOT has been assigned to duty as brigadier general, Corps of Engineers, National Army, principal assistant to the chief of engineers, United States Army, especially charged with the organization, training and replacement of engineer troops for foreign service in the present war. He has also been placed in command of the garrisoned Engineer Post at Washington Barracks and of its subposts, Fort Foote and Belvoir, on the Potomac, and also in charge of the cantonment at American University, City of Washington, where considerable forces of special engineer troops for service abroad are being organized and trained. General Abbot was formerly on duty in New York as division engineer of the Northeast division, as department engineer of the Eastern Department and as district engineer of the Second New York district, having charge of the Ambrose channel, the Red Hook channel, the Bay Ridge channel and the river and harbor works on Long Island; and also of the construction, preservation and repair of fortifications in New York harbor, and was on the board designing the land defense of New York City against attack by invading troops. While engaged on these duties he acted also as examining officer for commissioning some 775 candidates for commission in the Engineer Officers' Reserve Corps for service in France during the present war.

GUSTAVE R. TUSKA, consulting engineer, New York City, formerly chief engineer of the Panama R.R. Co., and lecturer in engineering at Columbia University, has been commissioned as major in the Engineer Officers' Reserve Corps.

J. B. EASTER, formerly assistant engineer on the Galveston, Harris-

burg & San Antonio Ry., in charge of location and construction of the Ft. Bliss spur, is now with the United States Reclamation Service, Rio Grande project, and engaged in locating a new main canal and lateral system.

GURDON G. BLACK, formerly engineer-in-charge of the supply and purifying section, St. Louis Department of Public Utilities, Water Division, has received a commission as captain in the Engineers' Corps, U. S. A., and is now acting adjutant, 314th Engineers, Camp Funston, Kansas.

JOHN C. PRITCHARD, principal assistant engineer, supply and purifying section, St. Louis Department of Public Utilities, Water Division, is now a first lieutenant in the 26th Engineers, at Camp Dix, N. J.

BRYANT WINSTON, formerly of the power plant section of the Department of Public Utilities, St. Louis, has received a commission as first lieutenant in the Engineers' Corps, United States Army.

R. W. GEARHART has resigned as county engineer of Buchanan County, Iowa, and is now county engineer of Linn County.

H. LESTER NEWHALL, formerly assistant engineer with the Public Service Commission, New York City, is now principal assistant to the chief engineer of Akron, Ohio, water-works.

A. H. GIBBS, of Ilwaco, Wash., has been appointed town engineer.

J. E. NELSON, engineer for the State Highway Department, Oregon, who has been in charge of paving work in Clatsop County, has gone to Wolf Creek, on state work.

ALBERT O. TRUE, sanitary engineer, New York State Department of Architecture, has received a captain's commission in the Engineer Officers' Reserve Corps.

GEORGE D. WHITTLE, highway bridge engineer with the Federal Office of Public Roads and Rural Engineering, has been transferred from Washington to the district office at San Francisco, and will handle the highway bridge work arising in the Western states under the Federal Aid Road Act.

ALLEN F. BREWER, formerly mechanical engineering inspector attached to the Valuation Department, Public Utilities Commission of New Jersey, is now with the American International Shipbuilding Corporation, at its Philadelphia plant.

EDWIN G. PIERCE, consulting chemist for the Republic Motor Truck Co., Alma, Mich., has completed the equipment of a branch chemical and testing laboratory at Alma, which is in charge of C. S. Morgan, of the University of Wisconsin.

MAJ. R. G. THOMAS, Charleston, S. C., has been elected chairman by the State Highway Commission.

S. F. SHAW has been appointed chief engineer of the International Railways of Central America, with office at Guatemala City, Guatemala. He succeeds E. H. STEWART, resigned. Mr. Shaw will have charge of engineering additions and betterments and right of way in Guatemala.

C. R. CHANDLER, assistant engineer of the International Railways of Central America, at Guatemala City, has been appointed engineer of maintenance-of-way.

H. G. LAIRD, superintendent of timber preservation at Gainesville, Fla., has succeeded L. L. SPARROW as engineer of roadway of the Atlantic Coast Line at Jacksonville, Fla. Mr. Sparrow has been appointed office engineer.

GEORGE H. BROWN, division engineer of the Pennsylvania R.R. at Harrisburg, Penn., has been appointed acting principal assistant engineer of the eastern Pennsylvania division, succeeding A. B. CUTHBERT.

FRED OHRT, formerly assistant engineer for the city and county of Honolulu, H. T., has been appointed sanitary engineer to the city Board of Health. He takes the place of S. W. TAY, called into the naval militia service.

E. C. WRIGHT succeeds P. A. BEATTY as division engineer, with office at Wheeling, W. Va., Baltimore & Ohio R.R. Mr. Wright was formerly district bridge inspector, Maryland district.

J. B. MARCELLUS, recently division engineer, Portland Cement Association, Kansas City, Mo., has been appointed state drainage and irrigation engineer of Kansas, with office at Manhattan. He is a graduate of Kansas State University Engineering School, and his work will be done in connection with the extension division of the State Agricultural College.

N. M. STINEMAN, formerly chief engineer for the LaSalle Engineering Co., Chicago, is now a captain in the Engineer Officers' Reserve Corps, and is at the second officers' training camp, at Ft. Leavenworth, Kansas.

S. L. RICE, who was with the Pennsylvania R.R. at Baltimore, is now in the construction division, U. S. Army, engaged in building aviation camps. He is stationed at Dayton, Ohio.

OSCAR P. LAUBSCHER, formerly with George B. Post & Sons, New York, and D. H. Burnham & Co., Chicago, is now with the Federal Bridge and Structural Co., Waukesha, Wis., and engaged at Savannah, Ga., in the preparation of plans and shop details for ship construction.

L. M. RUSSELL, city engineer of Elkhart, Ind., resigns this position Dec. 1 to become associated with ARTHUR J. SWEET, consulting engineer, Milwaukee.

O. S. MAPLE, formerly with the Fargo Engineering Co., Jackson, Mich., and the Texas Power & Light Co., Dallas, Tex., is now a purchasing assistant in the purchasing division of the Emergency Fleet Corporation, Washington, D. C.

CAPT. ALEXANDER MACOMBER, of the Engineer Reserve Corps, in addition to his other duties has been assigned to the command of the Provisional Anti-Aircraft Searchlight Detachment, and has been ordered to Washington Barracks.

LIEUT.-COL. JAMES G. STEESE, Corps of Engineers, U. S. Army, has been relieved from duty at the engineer officers' training camp, Ft. Leavenworth, Kan., and from assignment to the 7th U. S. Engineers, and has been appointed assistant to the chief of engineers, Washington, D. C. Lieut.-Col. Steese has served two tours of duty on the construction of the Panama Canal and Panama Railroad, and was recently Assistant Professor of Engineering at the United States Military Academy.

CAPT. R. R. JONES, chief assistant engineer of Cincinnati, District No. 1, Corps of Engineers, was installed Nov. 12 as officer in charge of the district, relieving COL. LANSING H. BEACH, U. S. division engineer.

CHARLES J. POPELKA, formerly assistant city engineer of Beloit, Wis., is now a second lieutenant in the Engineer Officers' Reserve Corps, and is at the Ft. Leavenworth, Kan., training camp.

JAMES G. COONEY, who was a resident engineer with the Illinois State Highway Department, has become connected with the valuation department of the Interstate Commerce Commission at Chicago.

FREDERICK B. JUDGE, formerly engineer for the American Phosphate Mining Co., Tiger Bay, Fla., is now a first lieutenant at Camp American University, Washington, D. C., in the 20th (Forestry) Engineers.

WILSON FITCH SMITH was recently appointed by the United States Shipping Board, Emergency Fleet Corporation, resident engineer in the Division of Shipyard Plants. He is stationed with the Merchants' Shipbuilding Corporation at Philadelphia, Penn., which has a contract for building a shipyard at Bristol, Penn., in which it will construct 40 fabricated steel cargo

ships of 9000 tons dead weight each. For the past 11 years Mr. Smith was with the Board of Water-Supply, City of New York, as division engineer in charge of the construction of the Kensico Dam, Kensico Reservoir and adjacent portion of the Catskill aqueduct.

JEROME NEWMAN, consulting engineer, San Francisco, has removed his office from the Newhall Bldg. to the Alaska Commercial Building.

L. C. ALDEN, class of 1909, Rensselaer Polytechnic Institute, who received the French military cross of war for bravery in the ambulance service, has joined the Engineer Corps, U. S. Army, in France. L. L. JOHNSON, a member of the class of 1907, is now in British Columbia recuperating from the effects of gas and a wound in the hip, received at the taking of Vimy Ridge. He has also received the military cross.

W. G. STROMQUIST, sanitary engineer with the United States Public Health Service, who was until recently in Wyoming making sanitary surveys of towns and mining camps, has been transferred to the Rural Sanitation Division which has its headquarters at St. Louis.

OBITUARY

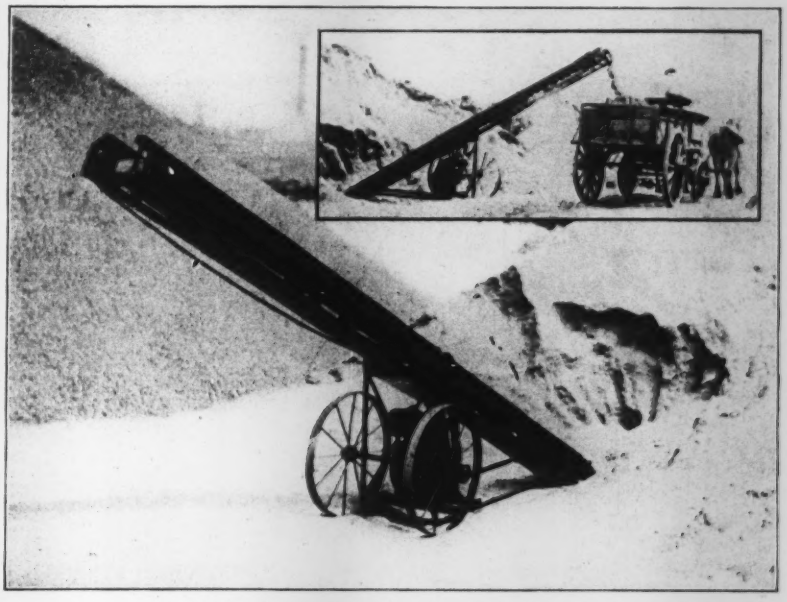
JAMES H. WRIGHT, civil engineer and graduate of Purdue University, died on Nov. 19 at his home at Rockaway Park, N. Y. Mr. Wright, his wife and young daughter were asphyxiated by gas. He was engaged in government construction work at Rockaway Beach for the Stewart Construction Co., New York, with which he was connected nine years. Mr. Wright was formerly in the engineering department of the Illinois Central R.R., and was also employed in highway construction for the New York State Highway Department about nine years ago.

APPLIANCES AND MATERIALS

Portable Conveyor Can Handle Stone and Sand

A new type of portable belt conveyor, known as the Pomaco Scoop Conveyor, has recently been put on the market by the Portable Machinery Co., Inc., of Passaic, N. J., and is the result of fifteen years' experience in the design and manufacture of material-handling equipment. Its makers claim that it will successfully handle coal of all grades, coke, ashes, crushed stone, sand, gravel, sacks, packages and manufactured products.

The name "scoop conveyor" has been given the apparatus because the conveying belt receives its load through a scoop which can be pushed or buried in the material to be handled. This is an exclusive feature of this particular machine and makes it possible for one man and the scoop conveyor to handle materials at the high rate of sometimes 1 ton per 1½ min. The material is raised on a carrying belt, the life of which depends a great deal on the nature of the material handled, though the manufacturers stand ready to guarantee the belt on receipt of specifications of operating conditions. The machines are furnished without power apparatus or with either electric-motor or gasoline-engine drive.

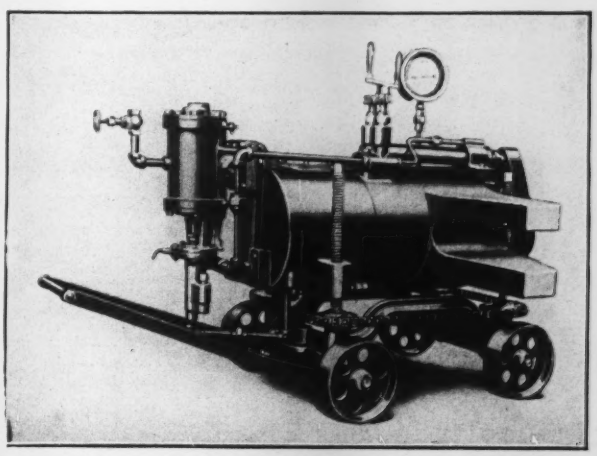


THIS CONVEYOR RECEIVES ITS LOAD THROUGH A SCOOP PUSHED INTO THE MATERIAL

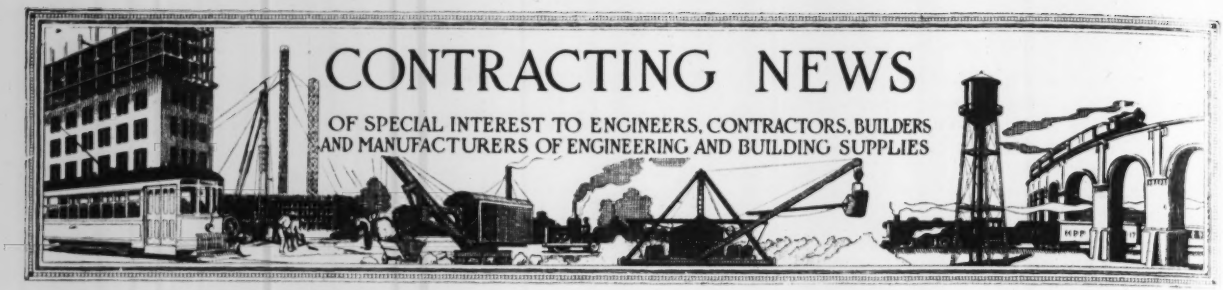
Portable Forcing Press Is Air Driven

A new type of portable press for forcing crankpins into locomotive and engine wheels, or for miscellaneous shop and field forcing work, has recently been put on the market by the Watson-Stillman Co., of New York. The unusual feature of this press is that the hand pump is replaced by one driven by compressed air. This makes the operation quicker and reduces the amount of labor necessary on work of this sort. To make the power connection it is necessary only to run a flexible tube or hose from the shop air-main to the pump engine as is done with pneumatic tools. The operating valves are so placed that the man in charge can actuate the press in addition to directing the work of the men under him. This is a direct elimination of one laborer, and the quicker operation of the air-driven engine speeds the work by approximately 300 per cent.

The press being equipped with a gage which accurately indicates the pressure, it is easy to detect a loose fit by a too easy entry of the pin being forced. This is very important in railroad work and in many other forcing jobs. The body of the press is mounted on screws having their reactions on a flat wheel truck. By turning these screws the center line of the ram can be raised or lowered to meet the center of the work. The ram, after advance, is returned by a small hydraulic cylinder mounted on the top of the press. These presses are built in capacities ranging up to 300 tons.



AIR-DRIVEN FORCING PRESS SAVES LABOR OF ONE MAN


CONTRACTING NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

Proposals

For Proposals Advertised See Pages 45 to 49 Inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Dec. 3.	Winnipeg, Man.	Nov. 8
Dec. 4.	Laurel, Mont.	Nov. 29
Dec. 5.	Red Bank, N. J. Adv. Nov. 22.	Nov. 22
Dec. 5.	Jackson, Mich. Adv. Nov. 29.	Nov. 29
Dec. 20.	Wooster, Ohio Adv. Nov. 29.	Nov. 29

SEWERS

Dec. 5.	Elyria, Ohio	Nov. 29
Dec. 10.	Lake Andes, S. D.	Nov. 22
Dec. 30.	Rocky River, Ohio	Nov. 29

BRIDGES

Dec. 3.	Akron, O.	Nov. 22
Dec. 3.	Laurel, Miss.	Nov. 22
Dec. 4.	West Palm Beach, Fla. Adv. Nov. 8 and 29.	Nov. 8
Dec. 10.	St. Augustine, Fla.	Nov. 15
Dec. 10.	St. Paul, Neb.	Nov. 29
Dec. 11.	Nelson, Pa.	Nov. 29
Dec. 12.	New York, N. Y.	Nov. 22
Dec. 21.	Kansas City, Mo. Adv. Nov. 29.	Nov. 29
Dec. 22.	Livingston, Ala.	Nov. 29

STREETS AND ROADS

Dec. 3.	Scottsboro, Ala.	Nov. 15
Dec. 3.	Washington	Nov. 22
Dec. 3.	Stanberry, Mo.	Nov. 22
Dec. 3.	San Diego, Cal.	Nov. 29
Dec. 3.	Eastville, Va.	Nov. 29
Dec. 3.	Kearney, Neb.	Nov. 29
Dec. 4.	Yreka, Cal.	Nov. 29
Dec. 4.	Elizabeth, N. J.	Nov. 29
Dec. 4.	Woodville, Miss.	Nov. 29
Dec. 4.	Tuscumbia, Ala.	Nov. 8
Dec. 4.	Columbus, Neb.	Nov. 15
Dec. 4.	Jefferson, Ia.	Nov. 29
Dec. 5.	Red Wing, Minn.	Nov. 15
Dec. 5.	Santa Ana, Cal.	Nov. 22
Dec. 6.	Jefferson City, Mo.	Nov. 29
Dec. 10.	Washington	Nov. 29
Dec. 10.	Gilmer, Tex.	Nov. 29
Dec. 11.	St. James, Minn.	Nov. 22
Dec. 11.	Granite Falls, Minn.	Nov. 22
Dec. 11.	Geneva, Ala.	Nov. 29
Dec. 11.	Pennsylvania Adv. Nov. 29.	Nov. 29
Dec. 12.	Anderson, Ind.	Nov. 29
Dec. 15.	Jasper, Ala.	Nov. 29
Dec. 15.	Fitchburg, Mass. Adv. Nov. 29.	Nov. 29
Dec. 27.	Elizabeth, N. J.	Nov. 29

EXCAVATION AND DREDGING

Dec. 4.	Salina, Kan.	Nov. 15
Dec. 4.	Litchfield, Minn.	Nov. 29
Dec. 5.	Anderson, Ind.	Nov. 29
Dec. 6.	Marion, O. Adv. Nov. 8.	Nov. 8
Dec. 10.	Clarion, Ia.	Nov. 29
Dec. 14.	El Centro, Cal.	Nov. 29
Dec. 20.	Albany, N. Y. Adv. Nov. 29.	Nov. 29

Close Bids		News-Record See Eng.

BUILDINGS

Dec. 1.	Nashua, N. H.	Nov. 29
Dec. 1.	Norfolk, Va.	Sept. 13
Dec. 1.	Glenville, W. Va.	Nov. 8
Dec. 3.	Olympia, Wash.	Nov. 15
Dec. 4.	Patton, Cal.	Nov. 29
Dec. 4.	Miami, Fla.	Nov. 29
Dec. 8.	Suffern, N. Y.	Nov. 22
Dec. 10.	East Cleveland (Cleveland P. O.) O.	Nov. 22
Dec. 15.	Gallup, N. M.	Nov. 29
Dec. 17.	Kenmore, Ohio	Nov. 29
Dec. 17.	New Paltz, N. Y. Adv. Nov. 29	Nov. 29
Dec. 17.	Pittsburgh, Kan.	Nov. 29
Dec. 18.	Kansas City, Mo. Adv. Nov. 29	Nov. 29
Jan. 1.	Wichita, Kan.	Nov. 22
Jan. 15.	New York, N. Y.	Nov. 29

INDUSTRIAL WORKS

Dec. 11.	Albany, N. Y. Adv. Nov. 29	Nov. 29

FEDERAL GOVERNMENT WORK

Nov. 30.	Dredging — New York, N. Y.	Nov. 29
Nov. 30.	Shop—New London, Conn.	Nov. 22
Dec. 3.	Incinerator — Mare Island (Vallejo P. O.) Cal.	Nov. 15
Dec. 3.	Dredging—Melville, R. I.	Nov. 22
Dec. 3.	Removal of Wall — New London, Conn.	Nov. 29
Dec. 3.	Surveying Instruments — Washington, D. C. Adv. Nov. 29.	Nov. 29
Dec. 3.	Grading — Wash., D. C. Adv. Nov. 29	Nov. 29
Dec. 3.	Pattern Shop — Washington, D. C.	Nov. 22
Dec. 5.	Post Office—Decatur, Ala.	Nov. 1
Dec. 5.	Bulkhead — New Orleans, La.	Nov. 8
Dec. 6.	Tank and Tower — Key West, Fla.	Nov. 29
Dec. 10.	Foam Fire Protection — Guantanoma, Cuba	Nov. 8
Dec. 10.	Heating System — Phila., Pa.	Nov. 15
Dec. 10.	Refrigerating Apparatus, etc.—Washington, D. C. Adv. Nov. 22.	Nov. 22
Dec. 10.	Heating System—Philadelphia, Pa.	Nov. 22
Dec. 10.	Cranes—Philadelphia, Pa.	Nov. 29
Dec. 10.	Piping, etc.—Philadelphia, Pa.	Nov. 29
Dec. 10.	Cranes — New London, Conn.	Nov. 29
Dec. 10.	Garage—Newport, R. I.	Nov. 29
Dec. 12.	Bridge—Fairmont, W. Va. Adv. Nov. 29	Nov. 29
Dec. 14.	Rip Rap—Galveston, Tex. Adv. Nov. 29.	Nov. 29
Dec. 17.	Post Office—Denton, Tex.	Nov. 8
Dec. 17.	Wharf and Boathouse—Santa Rosa, Fla. Adv. Nov. 29	Nov. 29
Dec. 18.	Laterals — Torrington, Wyo.	Nov. 1
Dec. 21.	Dredging — Philadelphia, Pa.	Nov. 29
Dec. 27.	Post Office — Alexandria, La. Adv. Nov. 22 and 29.	Nov. 22

Bids Close		See Eng. News-Record

MISCELLANEOUS

Dec. 3.	Steam Pipe and Fittings—San Jose, Cal.	Nov. 22
Dec. 4.	Plumbing and Electrical Work—Philadelphia, Pa. Adv. Nov. 29.	Nov. 29
Jan. 2.	Improving Harbor — Newport, Ore.	Nov. 29

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

WATER-WORKS

Proposed Work

N. Y., Coxsackie—Village having plans prepared by M. Vrooman, engr., West Main St., Gloversville, for filtration plant and dam. About $37,000. Noted Nov. 22.

N. Y., Olean—City lets contract about Dec. 5 building filtration plant, including 6 motor-driven centrifugal pumps, concrete mixing chambers, coagulating basins, filters, clearwell, brick operating basins, etc. About $75,000. E. H. Atwood, c/o. Vacuum Oil Co., engr. Noted Nov. 1.

N. J., Pitman—Boro. officials plans to purchase water-works of Pitman Water Co. for $48,000 and will extend and improve same.

Pa., Allentown—City plans to build 12-in. water main on Auburn St. from Liberty St. westward, about 2694 ft. long. About $10,755. C. D. Weisbach, city engr.

Pa., McKeesport — Boro. having plans prepared for new water-works to distribute water to Glassport and other boros. J. M. Smith, boro. engr.

Pa., Mt. Joy—Boro. had plans prepared building concrete filtration plant. About $15,000. Gannott, Seelye & Fleming, 204 Locust St., Harrisburg, engrs., soon let contract. Noted Aug. 23.

Va., Norfolk—City plans to issue $100,000 bonds to enlarge and improve water system. W. H. Taylor, Jr., city engr.

Ga., Decatur—(Official) — City election Dec. 5, to vote on $15,000 bond issue to build water system. E. S. Jordan, clk.

Tenn., Copperhill—(Official)—City to sell $10,000 bonds Dec. 1 to build water and sewerage systems. C. F. Hunter, clk.

Ky., Lawrenceburg—(Official)—City lets contract in spring, building addition to filtration plant. Cost between $13,000 and $15,000. C. A. Leathus, clk. Noted Nov. 15.

O., Cuyahoga Falls—See "Sewers."

O., Hamilton — City plans to improve water-works system. About $18,000. F. E. Weaver, city engr.

O., Maumee—City sold $10,500 bonds to extend water-works.

O., Maysville—City plans to build reservoir, 1,000,000 gal. capacity. A. D. Hewitt clk.

Ill., Wilmette—(Official)—City soon lets contract for 5000 ft. water pipe trenches 5 ft. deep. B. E. Gage, mgr. Wilemette Park Dist.

Wis., Gresham—City voted $14,000 bonds to build water system and electric light plant.

Wis., Hartford—City having plans prepared by A. Martin, engr., Hartford, for pump house and reservoir. About $20,000. Noted Nov. 8.